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ARTICLE XII.

Observations of the Magnetic Dip, made at several positions, chiefly on the south-western and north-eastern frontiers of the United States, and of the Magnetic Declination at two positions on the River Sabine; in 1840. By Major James D. Graham, of the United States' corps of Topographical Engineers. Read 16th August, 1844.

THE observations of the magnetic dip and declination, from the 29th of January to the 5th of June, 1840, contained in this paper, were made while I was attached to the joint commission for the demarcation of that portion of the boundary, between the United States and Texas, included between the mouth of the river Sabine and its intersection with the thirty-second degree of north latitude.

The observations for the dip, subsequent to that period, were made while I was serving as a commissioner, on the part of the United States, for the survey and exploration of the territory then in dispute with the government of Great Britain, upon our north-eastern frontier. The only apparatus in possession of the Commission for the demarcation of the boundary between the United States and Texas, that could be applied to the determination of the declination or horizontal variation of the magnetic needle, consisted of the surveyor's compasses furnished for the survey, and the needle of a theodolite. Although a good variation transit would have been preferred for this purpose, yet the want of such an instrument was, in a great measure, compensated for, by the use of three different needles instead of one. These were observed upon, with the poles direct, and then again, with the poles reversed. In every instance, the errors of the instruments were compensated, as far as practicable, by noting the readings of both ends of the needles, and by reversing the direction of the vanes of the compasses, and then making another set of readings in the same manner. When the theodolite needle was observed upon, both ends were read before, and then again, after a reversal, by a horizontal motion of the azimuth plate; and a mean of all the separate results was adopted, for the correct declination, at each station.

The observations for the magnetic dip were made with an instrument constructed by Troughton & Simms, of London, in the year 1838. It was obtained for the Commission for the Texan boundary survey, from Messrs. William Bond & Son, of Boston, for

whom it was made. The whole instrument is of brass. The azimuth circle is divided by the aid of a vernier to read to minutes. The vertical or dip circle is eight inches in diameter, divided, on a silver-washed surface, to read to fifteen minutes of arc. But, by the aid of a magnifying lens, the readings may easily be estimated to the nearest two minutes.

In the centre of the dip circle are two polished semi-cylindrical agate supports for the axis of the needle to rest upon. The central position of the needle is adjusted by two brass Y's, which can be raised or lowered, when necessary, to relieve the axis of the needle from the agates, or to adjust its bearing upon them. They also serve to shorten the vibrations of the needles, in order to diminish the time necessary for the readings. The instrument was supplied with two needles, each $7\frac{8.5}{100}$ inches long. The one designated as needle No. 1, is a parallelogram in shape, with rounded ends, marked by a fine line at each end, to indicate the centre of form. The other, designated as needle No. 2, is of the acute lozenge shape. The axes of these needles are of nicely polished steel. The box in which the instrument is packed is furnished with a pair of bar magnets, for reversing the poles of the needles; a magnifying lens, with a silvered reflector, for reading the angles; and the necessary adjusting tools. There is also a needle, three inches long, in a rectangular brass box, with a glass cover, with fixtures for attaching it upon the azimuth plate, parallel to the plane of the dip circle, for the purpose of bringing the latter to coincide with the magnetic meridian. When this is done, this small needle is removed. There are two short, but delicate, spirit-levels attached, at right angles to one another, to the moveable azimuth plate. These are levelled by three foot-screws, which support the instrument upon its stand. The needles are protected from the action of the wind by a glass cover, placed over the vertical or dip circle, the side next to the graduated face being readily opened for the necessary arrangements of the needles, reversing them on their axes, &c.

The needles are marked, upon one of the flat sides, and near one end, with the figures 1 and 2, respectively. This simple mark upon each needle serves to designate its number, its face, and its magnetic state. It is sufficient to refer to this number to designate the needle observed upon, and all the changes of position of which it is susceptible. In making the observations, the following method was always pursued; namely,—Both ends of the needle were read, with the face of the dip circle to the east, and also to the west, and with the face or marked side of the needle twice to the east and twice to the west; that is, once each way, by a change of direction of the face of the instrument, and once each way, again, by a reversal of the needle on its axis. A mean of all the readings was then taken and noted. The poles of the needle were then changed, and the same course repeated, and a mean of all the readings noted. A mean of these two results was taken, for the dip indicated by the needle. The same operation was then performed with the other needle, and a mean of the final results of the two needles was adopted as the magnetic dip for the station. Care was always taken, in selecting positions for observation, both for the dip and the declination, to have them beyond the reach of influence upon the needles, arising from the iron in buildings, or from any other local cause. The magnets—all iron or steel in the shape of keys, penknives, the cooking utensils belonging to the camp, &c.—were always kept remote from the instrument during the observations,

and were always sent in a direction east or west (magnetic) of the instrument, in order thus to neutralize all influence upon the needles.

The close coincidence in the results of the two dipping needles which was still exhibited, after the accident by lightning, to needle No. 2, described hereafter, will serve as a striking illustration of the importance of the several reversals, of the face of the instrument, of the face of the needles, by turning their axes end for end, and of the poles. Previous to that accident, the indications by needle No. 2, were quite as uniform throughout its various positions, as those by needle No. 1. After the accident, needle No. 2 always exhibited a variation in its extreme indications, arising from change of position, amounting to ten, and, sometimes, to nearly twelve degrees!! Still, the mean of all the observations made, in the manner described, seems to have agreed as well, or nearly as well, as before the accident, with the dip indicated by needle No. 1, which always remained in good order.

The absolute error of needle No. 2, seems to have been constant, or very nearly so, but by the several reversals of position, and of the poles, this error was rendered as often *positive* in its character as it was *negative*, and was thus neutralized, or very nearly so. In order to show the characters of the two needles in the various positions necessary for a course of observations, both before and after the accident to No. 2, all the readings are given for two sets of observations by each needle, both prior to and subsequent to that period; namely, for the stations at the light-house of the south-west pass of the Mississippi, and the mouth of the River Sabine, where observations were made before that accident, and for Gaines' Ferry, in Texas, and West Point, New York, where observations were made after the accident. It was at this last-mentioned position that needle No. 2 was observed upon, for the last time, on the 24th of August, 1840.

Its place was afterwards substituted by two other needles, marked No. 3 and 4. They were made expressly for me, by Mr. J. N. Baur, of New York, and are of the acute lozenge shape, very similar, in form, to No. 2.

In order to show the characters of the two new needles, it has been thought important to give a full set of observations by each of them. These are exhibited in the first observations that were made with them, immediately after they were magnetized; namely, for the station 4578 feet directly north from the monument erected to designate the source of the river St. Croix, under the fifth article of the treaty of 1794. They will be found under the dates of October 18th and 20th, 1840.

The needles were always charged as strongly as practicable, and generally to saturation, both when the poles were direct and also when reversed. This is an important object in observing the dip, for the stronger the needles are charged with magnetism, the less is the effect of any want of perfect balance, or any imperceptible dust or other particles that may adhere to them, to deflect them from the true angle of dip.

The localities occupied by the instrument, at the several stations, have been minutely described, in order that they may be easily found by future observers, and that an exact comparison of results may be made, and the change of dip, with the lapse of time, be the more accurately ascertained.

J. D. GRAHAM, Maj. Top. Engineers.

I. OBSERVATIONS FOR THE DIP OF THE MAGNETIC NEEDLE, WITH INSTRUMENT BY TROUGHTON AND SIMMS, OF LONDON.

Date and place of observation.—1840, January 29th. At the Light-House, South-West pass, mouth of Mississippi River. Latitude $28^{\circ} 58' 50''$, N.; Longitude $89^{\circ} 21' 27''$, W.

No. of Needle.	Polarity of Marked end of Needle.	Face of Instrument.	Marked side of Needle.	Mean solar time of observation. H. M.	North end of Needle reads	South end of Needle reads	Mean of both ends of needle.	Attached Thermometer. (Fahrenheit.)	Name of Observer.
					Deg. Mins. & Tenths.	Deg. Mins. & Tenths.	Deg. Mins. & Tenths.		
1	N	E	E	11.00 A.M.	59 . 08 . 0	58 . 48 . 0	58 . 58 . 0	67°	J. D. G.
"	"	W	W	" "	58 . 00 . 0	58 . 20 . 0	58 . 10 . 0		
"	"	W	E	" "	58 . 50 . 0	59 . 12 . 0	59 . 01 . 0		
"	"	E	W	" "	58 . 52 . 0	58 . 30 . 0	58 . 41 . 0		
1	S	E	E	2.40 P. M.	58 . 52 . 0	58 . 40 . 0	58 . 46 . 0		J. D. G.
"	"	W	W	" "	58 . 30 . 0	58 . 42 . 0	58 . 36 . 0		
"	"	W	E	4.05	57 . 15 . 0	57 . 35 . 0	57 . 25 . 0		
"	"	E	W	4.05	60 . 52 . 0	60 . 15 . 0	60 . 33 . 5		

Needle No. 1, with marked end north, gives $58^{\circ} 42' .5$
 Needle No. 1, with marked end south, gives $58^{\circ} 50' .12$
 Dip, by sixteen observations on needle No. 1, $58^{\circ} 46' .3$

2	S	W	W	4.30 P. M.	57 . 40 . 0	57 . 15 . 0	57 . 27 . 5	57 . 27 . 5	66°	J. D. G.
"	"	E	E	" "	58 . 30 . 0	58 . 35 . 0	58 . 32 . 5	58 . 32 . 5		
"	"	E	W	" "	57 . 10 . 0	57 . 35 . 0	57 . 22 . 5	57 . 22 . 5		
"	"	W	E	" "	58 . 30 . 0	58 . 17 . 0	58 . 23 . 5	58 . 23 . 5		
2	N	W	W	" "	58 . 35 . 0	58 . 15 . 0	58 . 25 . 0	58 . 25 . 0		J. D. G.
"	"	E	E	" "	59 . 35 . 0	59 . 30 . 0	59 . 32 . 5	59 . 32 . 5		
"	"	E	W	" "	59 . 45 . 0	59 . 23 . 0	59 . 34 . 0	59 . 34 . 0		
"	"	W	E	" "	59 . 57 . 0	59 . 40 . 0	59 . 48 . 5	59 . 48 . 5		

Needle No. 2, gives, with marked end north, $59^{\circ} 20'$
 With marked end south, $57^{\circ} 56' .5$
 Dip, by sixteen observations on needle No. 2, $58^{\circ} 38' .25$
 Dip, by sixteen observations on needle No. 1, $58^{\circ} 46' .3$
 Magnetic dip, at the Light-House of the South-West pass of the Mississippi,
 by a mean thirty-two observations on both needles, $58^{\circ} 42' .25$

NOTE.—The position chosen for the observations was about four hundred feet south-east of the new light-house, on Backus Island, which had been finished within a few days previous to these observations.

II. OBSERVATIONS FOR THE DIP OF THE MAGNETIC NEEDLE.

Date and place of observation.—1840, February 11th, at Dr. Everett's house, west bank of Sabine River, near its entrance into the sea; Texas. Latitude $29^{\circ} 43' 54''$, N.; Longitude $93^{\circ} 51' 30''$, west of Greenwich.

NOTE.—The point of observation of the magnetic dip bears, compared with the true meridian, north by west, $\frac{3}{4}$ P. W., and is distant $3\frac{23}{100}$ miles from mound A, which marks the western shore of the mouth of the river Sabine, in the maps showing the demarcation of the boundary between the United States and Texas.

1	S	W	W	11.35 A. M.	59 . 15 . 0	59 . 00 . 0	59 . 07 . 5		
"	"	E	E	0.25 P. M.	57 . 25 . 0	57 . 37 . 0	57 . 31 . 0		
"	"	E	W	0.50	59 . 00 . 0	59 . 15 . 0	59 . 07 . 5		
"	"	W	E	1.20	58 . 20 . 0	58 . 05 . 0	58 . 12 . 5		

No. of Needle.	Polarity of marked end of needle.	Face of Instrument.	Marked side of Needle.	Meansolar time of observation.	North end of Needle reads.	South end of Needle reads.	Mean of both ends of Needle.	Attached Thermometer. (Fahrenheit.)	Name of Observer.
				H. M.	Deg. Mins. & Tenths.	Deg. Mins. & Tenths.	Deg. Mins. & Tenths.		
1	N	E	E	2.0 P.M.	59 . 37 . 0	59 . 20 . 0	59 . 28 . 5		
"	"	W	W	2.45	57 . 38 . 0	58 . 05 . 0	57 . 51 . 5		
"	"	W	E	3.10	59 . 00 . 0	59 . 18 . 0	59 . 09		
"	"	E	W	3.25	58 . 15 . 0	58 . 00 . 0	58 . 07 . 5		

Needle No. 1, with marked end south, gives 58° 29'.6

Needle No. 1, with marked end north, gives 58 39.1

Dip, by sixteen observations on needle No. 1, 58 34.3

Clear, pleasant weather all day. Pleasant breeze from south-east. Air humid.

February 12th, at Dr. Everett's house.

2	N	E	E	10.20 A.M.	59 . 28 . 0	59 . 03 . 0	59 . 15 . 5		
"	"	W	W	10.55	59 . 17 . 0	59 . 45 . 0	59 . 31 . 0		
"	"	W	E	11.30	58 . 22 . 0	58 . 37 . 0	58 . 29 . 5		
"	"	E	W	11.55	59 . 30 . 0	59 . 15 . 0	59 . 22 . 5		
2	S	W	W	3.12 P.M.	57 . 25 . 0	57 . 00 . 0	57 . 12 . 5		
"	"	E	E	3.40	58 . 33 . 0	59 . 03 . 0	58 . 48 . 0		
"	"	E	W		57 . 10 . 0	57 . 25 . 0	57 . 17 . 5		
"	"	W	E		58 . 33 . 0	58 . 22 . 0	58 . 27 . 5		

Needle No. 2 gives, with marked end north, 59° 09'.6

With marked end south, 57 56.4

Dip, by sixteen observations on needle No. 2, 58 33

Dip, by sixteen observations on needle No. 1, 58 34.3

Magnetic dip at Dr. Everett's house, near the mouth of the river Sabine,

by a mean of thirty-two observations, on both needles, 58° 33'.65

February 17th, 1840. At Dr. Everett's house, west shore of the river Sabine, near its entrance into the sea, Texas; Latitude 29° 43' 54", N.; Longitude 93° 51' 30", west of Greenwich.

This night the star Polaris (α Ursæ Minoris) was observed upon at its greatest western elongation, in order to obtain the true meridian direction, to be used in observing the variation of the magnetic needle.

The observation was made with a good transit theodolite, (marked No. 2) by E. Draper, of Philadelphia. To avoid any error in transferring the azimuthal direction of the star while at its point of greatest elongation, to the surface of the ground, an artificial horizon of quicksilver was used, and the azimuth-plate of the theodolite was so adjusted, by the levelling screws, as to cause the vertical wire to bisect the star and its reflected image by a vertical sweep of the telescope, made a few seconds before the time of greatest elongation.

When the observation on the star was completed, the telescope was carefully brought to a horizontal position, and a lantern was placed upon the ground at a distance of one hundred and forty yards to the north, and so adjusted in position as to be bisected by the vertical wire. A stake was driven firmly into the ground to mark this point, and another to mark the position of the centre of the theodolite. Next morning, (February 18th,) the theodolite was adjusted carefully in its former position, and an angle of 1° 46' 15",

These stakes were to be permanent marks, while this station was occupied, for use in observing the horizontal declination of the needles.

February 18th. This night the star Polaris was again observed, when at its greatest western elongation, for the purpose of verifying the accuracy of the azimuth direction obtained by the observation of the 17th. The same means were adopted as before described, and the direction of the azimuth line corresponded with that obtained by the previous observation.

III. Magnetic bearing of the true meridian line, to ascertain the variation or horizontal declination of the needle. (Same station as II.)

First, by compass No. 3, by W. J. Young, of Philadelphia, needle six inches long.
At 2h. 00m., P. M.

North end of needle gives the variation,	8° 37' East.
South end of needle gives,	8° 36'
The end of the needle at 0, the compass vernier gives,	8° 35'

North end of needle reads,	8° 32'
South end of needle reads,	8° 33'
Compass vernier reads, (with end of needle at 0,)	8° 35'

At 5h. 30m., P.M. Vane A of compass to the north,—

North end of needle reads,	8° 44' East.
South end of needle reads,	8° 44'
Compass vernier reads, (with the end of needle at 0,)	8° 42'

North end of needle reads,	8° 45'
South end of needle reads,	8° 45'
Compass vernier reads, (with the end of needle at 0,)	8° 45'

Result, by needle of compass No. 3, with poles direct,	8° 34'.66
with poles reversed,	8° 44'.16

Variation of the needle of compass No. 3, by a mean of twelve observations
upon it, 8° 39'.4 E.

Second, by compass No. 4, by W. J. Young, of Philadelphia, needle five and a quarter inches long. At 1*h.* 32*m.*, P. M.

Vane A of compass to the north,—

North end of needle reads,	8° 42' East.
South end of needle reads,	8° 43'
Compass vernier reads, (with end of needle at 0,)	8° 43'

Vane A of compass to the south,—

North end of needle reads,	8° 42'
South end of needle reads,	8° 42'
Compass vernier reads, (with end of needle at 0,)	8° 42'

Reversed the poles of the needle by means of bar magnets, when the readings were as follow. At 6*h.* 00*m.*, P. M.:

Vane A of compass to the north,—

North end of needle reads,	8° 50' East.
South end of needle reads,	8° 50'
Compass vernier, with end of needle at 0, reads,	8° 47'

Vane A of compass to the south,—

North end of needle reads,	8° 47'
South end of needle reads,	8° 45'
Compass vernier, (with end of needle at 0,) reads,	8° 46'

Result, by needle of compass No. 4, with poles direct, 8° 42'.33
with poles reversed, 8° 47'.5

Variation of needle of compass No. 4, by a mean of twelve observations

upon it, 8° 44'.9

Third, by a small theodolite, by E. Draper, Philadelphia. Needle four and a half inches long.

At 3, P. M., north end of needle reads, 8° 34' East.
south end of needle reads, 8° 38'

North end of needle being at 0, vernier reads, 8° 34'

South end of needle being at 0, vernier reads, 8° 38'.5

Variation of needle of small theodolite by a mean of four readings, . . . 8° 36'.1 E.

This needle could not be conveniently taken out of the box, and therefore its poles were not reversed.

SUMMARY.

1st. Magnetic variation by twelve observations on needle of compass No. 3, 8° 39'.4

2d. " " by twelve observations on needle of compass No. 4, 8° 44'.9

3d. " " by four observations on the needle of the theodolite, 8° 36'.1

Magnetic variation at Dr. Everett's house, near the entrance of the river

Sabine into the sea, by a mean of twenty-eight observations on three

needles, February 19th, 1840, 8° 40'.1 E.

February 28, 1840. Observations on the dip of the magnetic needle, repeated at Dr. Everett's house, west bank of the river Sabine. Same station as II., occupied on the 11th and 12th of February. Latitude $29^{\circ} 43' 54''$, N.; Longitude $93^{\circ} 51' 30''$, W.

NEEDLE No. 1.

Polarity of Marked end	No. of Readings.	Time of Observation.	Dip observed.
N	8	11 <i>h.</i> 33 <i>m.</i> A.M.	$58^{\circ} 49'.6$
S	8	1 23 P.M.	$58^{\circ} 22'.4$
Dip, by sixteen readings of needle No. 1, . . .			$58^{\circ} 36'$

NEEDLE No. 2.

S	8	3 <i>h.</i> 36 <i>m.</i> P.M.	$57^{\circ} 49'.2$
N	8	4 28 "	$59^{\circ} 07'.4$
Dip, by sixteen readings of needle No. 2, . . .			$58^{\circ} 28'.3$
Dip, by sixteen readings of needle No. 1, as above,			$58^{\circ} 36'$
Dip, by a mean result from needles No. 1 and No. 2,			$58^{\circ} 32'.1$

Differing only 1'.5 from the result obtained from the same needles, at this station on the 11th and 12th of February, 1840.

A light south wind all day. The weather a little cloudy from sunrise till 1, P.M., when it was clear and nearly calm till sunset.

February 29th, 1840, at Dr. Everett's house, west shore of the Sabine River, near its entrance into the sea; Texas. Latitude $29^{\circ} 43' 54''$, N.; Longitude $93^{\circ} 51' 30''$, W. Same station as II.

IV. Observations for the magnetic variation were this day repeated at the same station which was occupied on the 19th instant, the magnetic bearing of the true meridian line was as follows, viz.:

First, by compass No. 3, by W. J. Young, of Philadelphia, needle six inches long. At 11*h.*, A.M. Vane A of compass to the north,—

North end of needle reads,	$8^{\circ} 43'$ East.
South end of needle reads,	$8^{\circ} 40'$
Compass vernier, with end of needle at 0, reads,	$8^{\circ} 43'$

Vane A of compass to the south,—

11 <i>h.</i> 10 <i>m.</i> , A.M., north end of needle reads,	$8^{\circ} 45'$
South end of needle reads,	$8^{\circ} 45'$
Compass vernier, (with the end of the needle at 0,) reads,	$8^{\circ} 42'$

Mean of the six readings of compass No. 3, with poles reversed, or, as left

on the 19th instant,	$8^{\circ} 43'$ East.
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Second, by compass No. 4, by W. J. Young, Philadelphia, needle five and a quarter inches long. At 11*h.* 30*m.* A.M. Vane A of compass to the north,—

North end of needle reads,	$8^{\circ} 45'$ East.
South end of needle reads,	$8^{\circ} 45'$
Compass vernier, (with the end of the needle at 0,) reads,	$8^{\circ} 45'$

11*h.* 40*m.*, A. M., vane A of compass to the south,—

North end of needle reads,	8° 46' East.
South end of needle reads,	8° 47'
Compass vernier, with needle at 0, reads,	8° 47'

Mean of these six readings of compass No. 4, with poles reversed, or, as

left on the 19th instant,	8° 45'.8
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Changed the poles of the needles of both compasses, by means of the bar magnets, thus making them direct again, when the readings were as follows, viz.:

Third, by compass No. 3. At 0*h.* 50*m.* P. M. Vane A of compass to the north,—

North end of needle reads,	8° 40' East.
South end of needle reads,	8° 38'
Compass vernier, (with the end of needle at 0,) reads,	8° 40'

1*h.* 00*m.*, P. M., vane A of compass to the south,—

North end of needle reads,	8° 38'
South end of needle reads,	8° 40'
Compass vernier, (with the end of needle at 0,) reads,	8° 38'

Mean of six observations on compass No. 3, with poles of the needle direct, 8° 39'

“ “ “ “ “ with poles reversed, 8° 43'

Variation of needle of compass No. 3, by a mean of twelve observations

upon it,	8° 41'
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Fourth, by compass No. 4, at 1*h.* 07*m.*, P. M. Vane A of the compass to the north,—

North end of needle reads,	8° 45' East.
South end of needle reads,	8° 45'
Compass vernier, (with the end of needle at 0,) reads,	8° 45'

Vane A of compass to the south,

North end of needle reads,	8° 45'
South end of needle reads,	8° 45'
Compass vernier, (with end of needle at 0,) reads,	8° 45'

Mean of six observations on compass No. 4, with poles direct, 8° 45' East.

“ “ “ “ “ with poles reversed, 8° 45'.8

Variation of needle of compass No. 4, by a mean of twelve observations

upon it,	8° 45'.4 East.
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Fifth, by the small theodolite by E. Draper, of Philadelphia. Needle four and a half inches long. End A of needle-box to the north.

At 4 <i>h.</i> 10 <i>m.</i> , P. M.—North end of needle reads,	8° 32' East.
South end of needle reads,	8° 34'

End A of needle at 0, vernier reads, 8° 34'

Revolved the instrument 180° in azimuth, bringing end A of needle-box to the south.

4 <i>h.</i> 30 <i>m.</i> P. M.—North end of needle reads,	8° 35'
South end of needle reads,	8° 36'

End A of needle at 0, vernier reads, 8° 37'

Mean of these six readings of the needle of the small theodolite, with the poles direct, $8^{\circ} 34'.6$ E.

Sixth, by the same instrument, the poles of the needle having been reversed.

At 5h. 15m., P.M., end A of compass box to the north,—

North end of needle reads, $8^{\circ} 35'$ East.

South end of needle reads, $8^{\circ} 35'$

South end of needle at 0, vernier reads, $8^{\circ} 34'$

Mean of these six readings of small theodolite, with the poles of the needle reversed, $8^{\circ} 34'.8$ E.

Mean of six readings of small theodolite with poles direct, $8^{\circ} 34'.6$

Variation of theodolite needle by a mean of twelve observations upon it, . . . $8^{\circ} 34'.7$ E.

SUMMARY.

1. Magnetic variation, by twelve observations on needle of compass No. 3, six inches long, $8^{\circ} 41'$ East.
2. Magnetic variation, by twelve observations on the needle of compass No. 4, five and a quarter inches long $8^{\circ} 45'.4$
3. Magnetic variation by twelve observations on the needle of the theodolite, four and a half inches long, $8^{\circ} 34'.7$

Magnetic variation at Dr. Everett's house, near the entrance of the river Sabine into the sea, in latitude $29^{\circ} 43' 54''$, N.; longitude $93^{\circ} 51' 30''$, W.; by a mean of thirty-six observations on three needles February 29, 1840, $8^{\circ} 40'.3$ E.

This day was clear, with flying clouds, and a moderate breeze from south south-east; the atmosphere tolerably dry.

Remark.—It will be observed that the variation of the theodolite needle was scarcely affected by reversing its poles, and that the mean result obtained for the magnetic variation by this day's observations differs only two-tenths of a minute, or twelve seconds, from the mean result obtained on the 19th of February.

V. OBSERVATIONS FOR THE DIP OF THE MAGNETIC NEEDLE.

Date and place of observation.—1840, May 28th. At Gaines's Ferry, (Pendleton,) on the west or right bank of Sabine River; Texas. Latitude $31^{\circ} 28' 15''$, N.; Longitude $93^{\circ} 44' 33''$, W.

No. of Needle.	Polarity of marked end of needle.	Face of Instrument.	Marked side of Needle.	Meansolar time of observation.	North end of Needle reads.	South end of Needle reads.	Mean of both ends of Needle.	Attached Thermometer. (Fahrenheit.)	Name of Observer.
				H. M.	Deg. Mins. & Tenths.	Deg. Mins. & Tenths.	Deg. Mins. & Tenths.		
1	N	E	E	0.20 P.M.	60 . 08 . 0	60 . 25 . 0	60 . 16 . 5		J.D.G.
"	"	W	W	1.10	61 . 40 . 0	61 . 22 . 0	61 . 31 . 0		
"	"	W	E	1.41	60 . 45 . 0	60 . 23 . 0	60 . 34 . 0		
"	"	E	W	2.13	61 . 35 . 0	62 . 00 . 0	61 . 47 . 5		

A very light north-east wind. Weather clear, and the atmosphere very dry all day.

No. of Needle.	Polarity of Marked end of Needle.	Face of Instrument.	Marked side of Needle.	Mean solar time of observation. H. M.	North end of Needle reads		South end of Needle reads		Mean of both ends of needle. Deg. Mins. & Tenths.	Attached Thermometer. (Fahrenheit.)	Name of Observer.
					Deg.	Mins. & Tenths.	Deg.	Mins. & Tenths.			
1	S	E	E	4 . 45 P.M.	60 . 35.0		60 . 45.0		60 . 40.0		J. D. G.
"	"	W	W	5 . 40	60 . 05.0		60 . 00.0		60 . 02.5		
"	"	W	E	6 . 20	61 . 28.0		61 . 23.0		61 . 25.5		
"	"	E	W	6 . 23	61 . 50.0		62 . 00.0		61 . 55.0		

Needle No. 1, with marked end north, gives $61^{\circ} 02'.5$

Needle No. 1, with marked end south, gives $61^{\circ} 00'.75$

Magnetic dip, by sixteen observations on needle No. 1, $61^{\circ} 01'.6$

A very light south-west wind; weather clear, and the atmosphere very dry, all day.

May 29th, at Gaines's Ferry.

2	S	E	E	6 . 30 P.M.	55 . 15.0		55 . 30.0		55 . 22.5		
"	"	W	W	6 . 35	65 . 10.0		65 . 00.0		65 . 05.0		
"	"	W	E	6 . 40	55 . 35.0		55 . 15.0		55 . 25.0		
"	"	E	W	6 . 47	64 . 52.0		65 . 15.0		65 . 03.5		
2	N	W	W	7 . 05 A.M.	56 . 40.0		56 . 50.0		56 . 45.0		
"	"	E	E	7 . 12	65 . 55.0		65 . 35.0		65 . 45.0		
"	"	E	W	7 . 20	56 . 50.0		56 . 40.0		56 . 45.0		
"	"	W	E	7 . 25	66 . 00.0		66 . 25.0		66 . 12.5		

Needle No. 2, gives, with marked end north, $61^{\circ} 22'*$

With marked end south, $60^{\circ} 14'$

Dip, by sixteen observations on needle No. 2, $60^{\circ} 48'$

Dip, by sixteen observations on needle No. 1, $61^{\circ} 01'.6$

* It will be remarked that the difference between the readings of needle No. 2 with the marked side east, and those which it gives with the marked side west, is very great, amounting to an average of nearly ten degrees in the last observations made upon it. The needle has assumed this character since I parted with it at our camp near the mouth of the river Sabine, on the 17th of March last.

Lieutenant Lee, who has had charge of the instrument since that time until my arrival at Gaines's Ferry, on the 27th of May, states, that while observing upon it at Gaines's Ferry, in the early part of April last, a violent storm, accompanied with thunder and lightning, interrupted his observations.

He left the instrument in the observing tent with this needle suspended, as is usual, for observation, and retired to his own tent until the storm should subside. During his absence from it, a very severe shock of lightning occurred, which was sensibly felt by several persons in the neighbouring tents. After the storm was over, he returned to the instrument, and found that the needle had been thrown from its position by the shock of lightning, although the tent and the other parts of the instrument remained apparently uninjured.

Ever after this, the needle showed similar discrepant results in its direct and reversed positions on its axis, although the mean result by it did not appear to differ much more than formerly from that shown by needle No. 1. Needle No. 2 had, after the accident, evidently a warp in it, which had not before been perceived. This may have arisen from the effect of the lightning upon the fibres of the steel. The axis may also have possibly been thrown somewhat out of its former adjustment. I have thought that under all circumstances, it would be just to give, in the last observations and always hereafter, twice the weight to the results of needle No. 1 which are given to those of needle No. 2, and in this way to state the dip as deduced from both needles.

Accordingly, by the last observations,—

The result by needle No. 1, = $61^{\circ} 01'.6 \times 2 = 122^{\circ} 03'.2$

The result by needle No. 2, = $60^{\circ} 47'.9 \times 1 = 60^{\circ} 47'.9$

The sum, = $182^{\circ} 51'.1$

which, divided by 3, gives $60^{\circ} 57'$ for the dip deduced for Gaines's Ferry, on the 28th and 29th of May, 1840.

VI. May 29th, 1840.—At Gaines's Ferry, west bank of the Sabine river; Texas. Latitude $31^{\circ} 28' 15''$, N.; Longitude $93^{\circ} 44' 33''$, W. Same station as V.

Magnetic bearing of a true meridian line established by equal altitudes of the sun, to ascertain the variation of the magnetic needle.*

1. By compass No. 3, needle six inches long. Poles of needle *direct*.

A mean of six observations made as heretofore described, gives, . . . $8^{\circ} 35'.5$ E.

Mean time of observation, 9h. 05m., A.M.

Poles of needle *reversed*. A mean of six observations made as heretofore described, gives . . . $8^{\circ} 36'.6$

Mean time of observation, 10h. 45m., A.M.

Magnetic variation by twelve observations on the needle of compass No. 3, $8^{\circ} 36'$ E.

2. By compass No. 4, needle five and a quarter inches long. Poles of needle *direct*. A mean of six observations made as heretofore described,

gives, . . . $8^{\circ} 45'.5$ E.

Mean time of observation, 9h. 40m., A.M.

Poles *reversed*. A mean of six readings made as heretofore described, gives, $8^{\circ} 44'.6$

Mean time of observation, 11h. 05m. A.M.

Magnetic variation by twelve observations on needle of compass No. 4, . . $8^{\circ} 45'$ E.

5. By the compass belonging to the Texan commissioner; needle six inches long.

A mean of six observations made as heretofore described, . . . $8^{\circ} 40'.6$

Mean time of observation, 11h. 20m. A.M.

This needle could not conveniently be taken out of its box, and its poles were not therefore reversed.

SUMMARY.

1. Variation of the needle of compass No. 3, of six inches long, by a mean of twelve observations, . . . $8^{\circ} 36'$ E.

2. Variation of the needle of compass No. 4, of five and a quarter inches long, by a mean of twelve observations . . . $8^{\circ} 45'$

3. Variation of the needle of the Texan commissioner's compass, of six inches long, by a mean of six observations, . . . $8^{\circ} 40'.6$

Magnetic variation at Gaines's Ferry, Texas, in latitude $31^{\circ} 28' 15''$, N.; and longitude $93^{\circ} 44' 33''$, W.; by a mean of thirty observations on three needles, on the 29th of May, 1840, . . . $8^{\circ} 40'.5$ E.

* This true meridian line was fixed by my principal assistant, Lieutenant T. J. Lee, of the corps of topographical engineers, on the 10th of May, 1840, before my arrival at Gaines's Ferry. It was done by observing the \odot 's azimuth, at equal altitudes, A.M. and P.M., and correcting for the effect of the change of declination during the interval. Two stakes were driven to indicate the true meridian direction. The magnetic bearing of this line was observed by me with the several needles, as indicated.

NOTE.—The day was clear, with a very light north-east wind, and the atmosphere very dry.

From the difference in latitude between Everett's house, near the mouth of the river Sabine and Gaines's Ferry, amounting as it does, to $1^{\circ} 44' 21''$, it was supposed there would be found a considerable difference in the variation of the needle at these two places.—The results here reported show, however, no appreciable difference. On perceiving this, I was induced to apprehend there might have been some inadvertent error in the determination of the true meridian at the latter station. The calculations were therefore received with care, and were found to give the correct deduction from the observations as recorded.

Lieutenant Lee has full confidence in his observations for the determination of the true meridian at Gaines's Ferry. For this purpose two separate sets of observations were made by him of the sun's azimuth, at equal altitudes, A.M. and P.M., and the results coincided within thirteen seconds of arc. There could have been no error in the magnetic bearing of the line indicated by the stakes placed by him to mark the true meridian, as the many observations with the different compasses used, would no doubt have detected such error.

The determination of the true meridian at Everett's house was done with every possible care, by observations on the star Polaris, verified by two different night's observations, using, in both instances, an artificial horizon of quicksilver, and observing the azimuth of the star both direct and by reflection.

VII. June 4th and 5th, 1840.—Observations on the dip of the needle, at a point about seven hundred feet north of Polvido's house, near the left bank of Sabine River, Louisiana. Latitude $32^{\circ} 01' 01''$, N.; Longitude $94^{\circ} 00' 00''$, W.

NEEDLE No. 1.

Polarity of Marked end.	No. of Readings.	Time of Observation.	Dip observed.
S June 4,	8	12h. 20m. P.M.	$61^{\circ} 20'.25$
N June 5,	8	11 17 A.M.	$61^{\circ} 57'.75$
Dip, by sixteen observations on needle No. 1, . . .			$61^{\circ} 39'.0$

NEEDLE No. 2.

N June 5,	8	5h. 37m. P.M.	$61^{\circ} 53'.4$
S June 5,	8	6 32 "	$61^{\circ} 11'.9$
Dip, by sixteen observations on needle No. 2, . . .			$61^{\circ} 32'.6$
Dip, by sixteen observations on needle No. 1, . . .			$61^{\circ} 39'.0$

By giving to needle No. 1 twice the weight of No. 2, we get the following result for the dip at this station, viz :

$$\begin{aligned}\text{No. 1,} &= 61^{\circ} 39' \times 2, = 123^{\circ} 18' \\ \text{No. 2,} &= 61^{\circ} 32'.6 \times 1, = 61^{\circ} 32'.6 \\ \text{Sum,} & 184^{\circ} 50'.6\end{aligned}$$

Which, divided by 3, gives $61^{\circ} 36'.8$ for the magnetic dip at this station on the 4th and 5th of June, 1840.

NOTE.—The point of observation is N. 70° E., (compared with the *true* meridian,) and is distant two and a half miles from the intersection of the river Sabine with the 32° of north latitude.

Clear, calm, very hot and dry weather, during the observations.

VIII. Nachitoches, Louisiana.

June 26, 1840.—Observations on the dip of the needle, made in the small summer-house in Mr. Ochmichen's garden.

NEEDLE No. 1.

Polarity of Marked end of Needle.	No. of Readings.	Time of Observation.	Dip observed.
N	8		61° 26'.25
S	8	3h. P.M.	61° 05'.62

Dip by sixteen observations on needle No. 1, 61° 15'.9

The day was clear and very hot, with a gentle north-west wind all day.

There was not time to observe on needle No. 2 before the hour appointed for the steam-boat to depart, in which I was to descend the Red river.

IX. OBSERVATIONS FOR THE DIP OF THE MAGNETIC NEEDLE.

Date and place of observation.—1840, August 24th.—At West Point, New York.

Latitude 41° 23' 35", N.; Longitude 74° 01' W. The observations were made under a tent on the plain, about one hundred yards west of Execution Hollow, and remote from the batteries of artillery and other visible causes of local attraction.

Weather clear, with a fresh breeze from the north.

No. of Needle.	Polarity of Marked end of Needle.	Face of Instrument	Marked side of Needle.	Mean solartime of observation.	North end of Needle reads	South end of Needle reads	Mean of both ends of Needle.	Attached Thermometer. (Fahrenheit)	Name of Observer.
				H. M.	Deg. Mins. & Tenths.	Deg. Mins. & Tenths.	Deg. Mins. & Tenths.		
1	S	W	W	7.40 A. M.	72 . 05	72 . 25	72 . 15		J. D. G.
"	"	E	E	8.11	74 . 36	74 . 20	74 . 28		
"	"	E	W	9.00	72 . 42	72 . 22	72 . 32		
"	"	W	E	10.30	73 . 25	73 . 46	73 . 35.5		
1	N	W	W	11.30 A. M.	73 . 58	74 . 30	74 . 14		
"	"	E	E	11.48	72 . 33	72 . 16	72 . 24.5		
"	"	E	W	0.15 P. M.	74 . 30	74 . 07	74 . 18.5		
"	"	W	E	0.40	72 . 22	72 . 45	72 . 33.5		

Needle No. 1, with marked end south, gives 73° 12'.6

Needle No. 1, with marked end north, gives 73 22'.6

Dip, by sixteen observations on needle No. 1, 73 17'.6

2	S	W	W	3.20 P. M.	78 . 20	78 . 45	78 . 32.5		
"	"	E	E	3.27	68 . 33	68 . 05	68 . 19		
"	"	E	W	3.35	78 . 22	78 . 00	78 . 11		
"	"	W	E	3.40	68 . 03	68 . 22	68 . 12.5		
2	N	W	W	4.05 P. M.	68 . 45	69 . 03	68 . 54		
"	"	E	E	4.10	78 . 37	78 . 15	78 . 26		
"	"	E	W	4.18	68 . 55	68 . 30	68 . 42.5		
"	"	W	E	4.25	77 . 50	78 . 15	78 . 05		

Needle No. 2, with marked end south, gives, 73° 18'.75

Needle No. 2, with marked end north, 73 31'.37

Dip, by sixteen observations on needle No. 2, 73 25'.06

A direct mean between the results of No. 1 and No. 2 is, 73 21'.3

By giving twice the weight to No. 1 which is given to No. 2, the dip will be, 73° 20'.09

NOTE.—This is the last observation ever made with needle No. 2. It was broken, a few days afterwards in an attempt to correct it of the warp which occurred from the accident described at page 339. Two other needles were subsequently made for this instrument by Mr. J. N. Baur, a very ingenious mechanic of New York. They are designated as No. 3 and 4 in the observations which follow, and proved to be remarkably good needles.

X. OBSERVATIONS FOR THE DIP OF THE MAGNETIC NEEDLE.

Date and place of observation.—1840, October 18th.—At astronomical station, four thousand five hundred and seventy-eight feet due north from the monument at the source of the river St. Croix; on the boundary between Maine and New Brunswick. Latitude $45^{\circ} 57' 23''.6$, N.; Longitude $67^{\circ} 46' 45''$, west of Greenwich.

No. of Needle.	Polarity of marked end of needle.	Face of Instrument.	Marked side of Needle.	Meansolar time of observation.	North end of Needle reads.	South end of Needle reads.	Mean of both ends of Needle.	Attached Thermometer. (Fahrenheit.)	Name of Observer.
				H. M.	Deg. Mins. & Tenths.	Deg. Mins. & Tenths.	Deg. Mins. & Tenths.		
3	N	E	E	1.30 P.M.	76 . 37	76 . 15	76 . 26		J.D.G.
"	"	W	W	1.45	77 . 05	77 . 28	77 . 16.5		
"	"	W	E	1.50	76 . 15	76 . 35	76 . 25		
"	"	E	W	1.55	77 . 30	77 . 07	77 . 18.5		

Weather clear and dry.

3	S	E	E	2.40 P.M.	77 . 10	76 . 52	77 . 01	52°	J.D.G.
"	"	W	W	2.48	76 . 57	77 . 07	77 . 02		
"	"	W	E	3.00	76 . 55	77 . 15	77 . 05		
"	"	E	W	3.10	77 . 08	76 . 52	77 . 00		

Needle No. 3, with marked end north, gives, $76^{\circ} 51'.5$

Needle No. 3, with marked end south, gives, $77^{\circ} 02'$

Dip by sixteen observations on needle No. 3, $76^{\circ} 56'.75$

1840—October 20th.—At the same station, observed on needle No. 4 as follows, viz.:

4	N	E	E	11.05 A.M.	75 . 45	75 . 15	75 . 30	60°	J.D.G.
"	"	W	W	11.20	77 . 50	78 . 10	78 . 00		
"	"	W	E	11.25	75 . 20	75 . 20	75 . 20		
"	"	E	W	11.30	78 . 05	77 . 50	77 . 57.5		
4	S	E	E	0.15 P.M.	78 . 38	78 . 15	78 . 26.5	61°5	J.D.G.
"	"	W	W	0.25	75 . 30	75 . 45	75 . 37.5		
"	"	W	E	0.30	78 . 08	78 . 22	78 . 15		
"	"	E	W	0.38	76 . 40	76 . 10	76 . 25		

It was raining the whole time occupied in observing on needle No. 4, to-day, and the atmosphere was very moist, but the needle and its axis, and also the agate supports at the centre of the dip circle, were kept as dry as possible by frequently wiping them with soft chamois leather.

Needle No. 4 gives, with marked end north, $76^{\circ} 41'.87$

With marked end south, $77^{\circ} 11'$

Dip by sixteen observations on needle No. 4, $76^{\circ} 56'.43$

NOTE.—Needles No. 3 and No. 4, made by J. N. Baur, of New York, were furnished by him unmagnetized. They were magnetized on the 18th of October, and the above are the first observations ever made with them.

Date and place of observation.—1840—October 20th.—At the same station as before.

1	S	E	E	2.15 P.M.	78 . 30	78 . 19	78 . 24.5	63°	J.D.G.
"	"	W	W	2.55	75 . 40	75 . 55	75 . 47.5	63	
"	"	W	E	3.27	76 . 07	76 . 25	76 . 16	60	
"	"	E	W	3.55	78 . 27	78 . 10	78 . 18.5	61	

At 2h. 55m., cloudy: 3h. 27m., raining: 3h. 55m., sky clear, flying clouds.

October 21st, reversed the poles of needle No. 1, and observed as follows:

No. of Needle.	Polarity of marked end of Needle.	Face of Instrument.	Marked side of Needle.	Meansolar time of observation.	North end of Needle reads	South end of Needle reads	Mean of both ends of Needle.	Attached Thermometer. (Fahrenheit.)	Name of Observer.
				H. M.	Deg. Mins. & Tenths.	Deg. Mins. & Tenths.	Deg. Mins. & Tenths.		
1	N	E	E	4.15 P.M.	76 . 15	75 . 52	76 . 03.5	53°	J. D. G.
"	"	W	W	4.30	77 . 30	77 . 52	77 . 41	53	
"	"	W	E	4.38	75 . 40	75 . 55	75 . 47.5	53	
"	"	E	W	5.05	77 . 37	77 . 35	77 . 36	53	

Needle No. 1, with marked end south, gives, October 20th, 77° 11'.6

Needle No. 1, with marked end north, gives, October 21st, 76° 47'

Dip, by sixteen observations on needle No. 1, 76° 59'.3

RECAPITULATION,

Showing the result of all the observations on needles Nos. 1—3, 4, for the magnetic dip, at the first astronomical station of the north-eastern boundary survey, being four thousand five hundred and seventy-eight feet due north of the monument erected at the source of the river St. Croix; made on the 18th, 20th, and 21st of October, 1840:

1. By sixteen observations on needle No. 3, October 18th, 1840, 76° 56'.75
2. " " " No. 4, October 20th, 1840, 76° 56'.43
3. " " " No. 1, October 21st, 1840, 76° 59'.3

Magnetic dip at station four thousand five hundred and seventy-eight feet due north from the monument, by a mean of forty-eight observations on needles

Nos. 1, 3, and 4, October 18th, 20th, and 21st, 1840, 76° 57'.4

XI. November 27th, 1840.—Observations on the dip of the magnetic needle, at astronomical station, Park's hill, on the true meridian of the monument at the source of the river St. Croix. Latitude 46° 06' 40'', N.; Longitude 67° 46' 45'', W.

NEEDLE No. 3.

Polarity of Marked end.	No. of Readings.	Time of Observation.	Dip observed.
S	8	2h. 48m., P. M.	77° 03'
N	8	3 57 "	76° 55'.9

Dip, by sixteen readings of needle No. 3, 76° 59'.4

November 28th, 1840. At same station.

NEEDLE No. 4.

S	8	77° 23'.37
N	8	76° 48'.37

Dip, by sixteen readings of needle No. 4, November 28th, 77° 05'.87

November 29th,—at same station as above.

NEEDLE No. 3, REPEATED.

N	8	77° 03'
S	8	77° 01'.6

Dip, by sixteen readings of needle No. 3, November 29, 1840, 77° 02'.3

Dip, by sixteen readings of needle No. 4, November 28, " 77° 05'.87

Dip, by sixteen readings of needle No. 3, November 27, " 76° 59'.4

Magnetic dip at Park's Hill, by a mean of forty-eight observations, on needles

Nos. 3 and 4, made on the 27th, 28th, and 29th of November, 1840, . . . $77^{\circ} 02'.5$

The observations were made under a tent for the protection of the instrument; the snow nearly a foot deep upon the ground.

There was a slight fall of snow during the observations, on the 27th and 28th of November.

On the 29th it was cloudy. Needle No. 3 was more strongly charged with magnetism on the 29th than on the 27th. On the 29th pains were taken to charge it fully to saturation, and it vibrated more briskly than on the 27th.

A continuation of Observations on the Dip of the Magnetic Needle; embracing thirty-eight additional points in the United States, New Brunswick, and Canada, between Washington and the head waters of the River St. John. Made during the years 1841, 1843, and 1844. By James D. Graham, Major, United States Corps of Topographical Engineers. Read January 17, 1845.

The instrument with which the following observations were made, was constructed by Gambey, of Paris, and is probably one of the best that has come from the hands of that ingenious and skilful artist. The close coincidence which has uniformly been shown in the results of its two needles, and the consistency in the repeated readings requisite for the many sets of observations that have been made with it, seem fully to justify this remark.

It is constructed of gun-metal, except the cover for the dip-circle. This is a square box open at the base, for passing it over the dip-circle, and has a door opening and shutting on hinges, for convenience in placing and adjusting the needles, and is made chiefly of wood, and fine plate glass.

The vertical or dip-circle is ten inches in diameter, and is divided, as usual, into four quadrants of ninety degrees each. The degrees are divided each into six equal parts, or directly to ten minutes. These smaller divisions are easily subdivided by estimation, after a little practice, aided by the magnifying lenses that are attached to the instrument, to the nearest one or two minutes.

It has two needles, each nine and a half inches long, and nine-sixteenths of an inch wide in the middle where pierced by the axle. They are here gently rounded upon both narrow edges, and taper thence to a point at each extremity. They play entirely within the interior ring of the dip-circle, whose diameter is one-twentieth of an inch greater than the length of the needles, leaving one-fortieth of an inch clear space at each end of the needles. By this arrangement, all parallax in reading the angle of the dip is avoided.

The pivots of the steel axles rest, and roll freely when the needles vibrate, upon two polished agates, whose upper surfaces are of cylindrical form.

The usual arrangement is provided, of a pair of brass Y's, which can be raised and depressed at pleasure, to lift the needles from the agates, and set them down again, for the purpose of giving a new bearing of the axles, or to shorten the vibration of the needles.

The azimuth circle is an open ring eight inches in diameter, connected by six radial bars with the socket at the centre. The quantity of metal round about the needles is thus diminished without any sacrifice of strength or steadiness. This circle is divided into degrees, numbered round from 0 to 360° , and these again into half degrees, and the readings are to single minutes by means of a vernier.

For bringing the plane of the dip-circle to coincide with the magnetic meridian, there is a horizontal needle nine and a quarter inches long, whose socket at the centre, rests upon the point of a pin projecting from the middle of a steel axle, whose pivots rest in the Y's of the dip-circle. The pin which supports the horizontal needle is kept vertical, by the gravity of a brass bob, diametrically opposite to it, also attached to the axle, and which serves as a handle in adjusting the needle concentric with the dip-circle.

This part of the apparatus is, of course, removed when the plane of the dip circle is brought to coincide with that of the magnetic meridian. It was attached to the instrument after it was imported into this country, by Mr. James Green, mathematical instrument maker, in Baltimore.

A very delicate spirit-level is provided, for levelling in azimuth, by means of three foot-screws. A pair of bar magnets and a good thermometer with Fahrenheit's scale, are appendages to the instrument, and are conveniently packed in the travelling case.

The needles are designated by the figures 1 and 2 respectively, marked upon the flat sides.

The method of observing has been the same as was described in a preceding portion of this paper, read before the Society on the 16th of August, 1844. That is, the needles were always read at both ends, in four different positions, with the poles direct, and in the same number again with the poles reversed. Two of these four changes were, in each case, made by reversing the face of the dip circle, and the two others by reversing the ends of the axles upon the agates.

When the instrument was first observed upon, the needle was read four times successively in each of its positions with respect to the instrument, in order to ascertain the degree of coincidence of these several readings, the needle being lifted from the agates and allowed to assume its rest anew after each reading. These several readings were found to differ so little in the same relative position of the needle, seldom amounting to as much as three minutes, and usually not exceeding one or two minutes, that it was considered unnecessary to read more than twice in the same position in order to eliminate errors of reading or of position of the axles upon the agates. Hence each needle has been usually read only twice at each end, in the same position, though at several stations they have been read as many as three times at each end, in each position.

The needles were always raised from the agates and allowed to assume their positions anew, after each reading.

In order to show more clearly the mode of observing, and, what is not less important, the character of the instrument, the observations made at Washington on the 1st, 4th,

and 5th of June, 1841, and those made at the observatory of the Girard college, Philadelphia, on the 14th of the same month, are given in full detail. All the other observations are reported in an abbreviated form.

It is proper to remark, that, at all the stations embraced by this paper, the several readings of the two needles were quite as consistent as those reported at full length.

The latitude and longitude of every station are given. With the exception of the stations at Washington, Baltimore, Philadelphia, New York, Boston, Cambridge Massachusetts, and Portsmouth New Hampshire, these have been exclusively derived from numerous astronomical observations made by the author of this paper.

The precise locality of each station, with respect to conspicuous surrounding objects, is also given, to enable future observers to place their instruments upon the same points, in order to a fair comparison of results, and for a more satisfactory deduction of the periodical variation of the dip.

Although the instrument has been transported over about four thousand miles in the various journeys made with it, sometimes in rail-cars, sometimes in stage-coaches, sometimes in baggage wagons, over exceedingly rough roads, and sometimes in log and bark canoes, while navigating shoal rivers, abounding with rocks and dangerous rapids, yet it is uninjured in the slightest degree. The last observations made with it are quite as satisfactory as any of the series. This is to be attributed to the admirable manner in which the instrument is packed in its travelling-case, and the attention that was always bestowed to ensure its safety.

The temperature is always given by the scale of Fahrenheit.

The longitudes are always given west of Greenwich.

The time of observation given is always mean solar time, by civil reckoning.

XII. OBSERVATIONS FOR THE DIP OF THE MAGNETIC NEEDLE, WITH INSTRUMENT BY GAMBEY, OF PARIS.

Date and place of observation.—1841, June 1st.—Washington City, D. C. In the centre of the public garden, east of the capitol. Latitude $38^{\circ} 53' 30''$, N.; Longitude $77^{\circ} 01' 30''$, W.

No. of Needle.	Polarity of Marked end of Needle.	Face of Instrument	Marked side of Needle.	Mean solartime of observation.	North end of Needle reads		South end of Needle reads		Mean of both ends of Needle	Attached Thermometer. (Fahrenheit.)	Name of Observer.
				H. M.	Deg.	Mins. & Tenths.	Deg.	Mins. & Tenths.	Deg Mins. & Tenths.		
1	N	E	E	8.16 A. M.	71	. 15	71	. 18	71 . 16.5	76°	Major J. D. Graham.
"	"	"	"	8.20	71	. 14	71	. 18	71 . 16		
"	"	"	"	8.24	71	. 12	71	. 15	71 . 13.5		
"	"	"	"	8.30	71	. 11	71	. 15	71 . 13		
"	"	W	W	8.40	71	. 00	70	. 56	70 . 58	78	
"	"	"	"	8.45	70	. 57	70	. 52	70 . 54.5		
"	"	"	"	8.50	70	. 58.5	70	. 54	70 . 56.2	78	
"	"	"	"	8.55	70	. 59	70	. 55	70 . 57		
"	"	W	E	9.10	71	. 35	71	. 29	71 . 32	79	
"	"	"	"	9.12	71	. 35	71	. 27	71 . 31	80	
"	"	"	"	9.18	71	. 35	71	. 29	71 . 32		
"	"	"	"	9.20	71	. 35	71	. 28	71 . 31.5	81	
"	"	E	W	9.33	70	. 42.5	70	. 49	70 . 45.7	82	
"	"	"	"	9.35	70	. 44	70	. 50	70 . 47		
"	"	"	"	9.37	70	. 43	70	. 49	70 . 46	83	
"	"	"	"	9.40	70	. 43	70	. 48	70 . 45.5	84	

No. of Needle.	Polarity of Marked end of Needle.	Face of Instrument.	Marked side of Needle.	Mean solar time of observation.	North end of Needle reads		South end of Needle reads		Mean of both ends of needle.	Attached Thermometer. (Fahrenheit.)	Name of Observer.
				H. M.	Deg.	Mins. & Tenths.	Deg.	Mins. & Tenths.			
1	S	E	E	10.28 A. M.	70	. 52.5	70	. 58	70 . 55.2	84°	Major J. D. Graham.
"	"	"	"	10.34	70	. 53	70	. 58	70 . 55		
"	"	"	"	10.36	70	. 53.5	70	. 57	70 . 55.2		
"	"	"	"	10.38	70	. 54	70	. 58	70 . 56		
"	"	W	W	10.45	72	. 09	72	. 04	72 . 06.5		
"	"	"	"	10.46	72	. 10	72	. 02	72 . 06		
"	"	"	"	10.48	72	. 10	72	. 05	72 . 07.5	88	
"	"	"	"	10.50	72	. 11	72	. 04	72 . 07.5		
"	"	W	E	10.56	71	. 22.5	71	. 18.5	71 . 20.5		
"	"	"	"	10.57	71	. 24	71	. 17	71 . 20.5		
"	"	"	"	10.58	71	. 24	71	. 19	71 . 21.5		
"	"	"	"	10.59	71	. 22.5	71	. 17.5	71 . 20		
"	"	E	W	11.05	71	. 14	71	. 19	71 . 16.5		
"	"	"	"	11.06	71	. 14	71	. 18	71 . 16		
"	"	"	"	11.08	71	. 14	71	. 18	71 . 16		
"	"	"	"	11.09	71	. 14	71	. 17.5	71 . 15.7		

Needle No. 1, gives, with marked end north, 71° 07'.27
 with marked end south, 71° 24'.72

Dip, by sixty-four observations on needle No. 1, 71° 16'

Four readings were taken of the needle in each position, in order to test the consistency of the several results. After each reading, the needle was raised from the agate supports and allowed to assume new points of rest upon the pivots.

The weather was clear and the atmosphere dry, and a very light south-easterly wind perceptible.

The above are the first observations ever made with this instrument. It arrived from Paris only a few weeks ago. Its two needles came unmagnetized, and were both magnetized this morning, before commencing the observations. Observations on needle No. 2 were omitted this day, in consequence of the high degree of temperature, and the difficulty of procuring a proper shade for the instrument, as late in the day as noon.

1841, June 4th.—Washington City, D. C. Near the centre of the public garden, east of the capitol, under an elm tree which is on the south margin of the northern middle avenue, or gravelled walk, running east and west.

2	S	E	E	7.20 A. M.	71	. 20	71	. 24	71 . 22	65°	J. D. G.
"	"	"	"	7.30	71	. 21	71	. 25	71 . 23		J. D. G.
"	"	W	W	7.45	71	. 07	70	. 59	71 . 03	68	J. N. N.
"	"	"	"		71	. 06	70	. 59	71 . 02.7		J. D. G.
"	"	W	E	8.00	71	. 39	71	. 34	71 . 36.5	68.5	J. N. N.
"	"	"	"		71	. 39.5	71	. 34	71 . 36.7		J. D. G.
"	"	E	W	8.07	71	. 34	71	. 39	71 . 36.5	70	J. N. N.
"	"	"	"		71	. 34	71	. 39.5	71 . 36.7		J. D. G.
2	N	E	E	8.50	70	. 51	70	. 56	70 . 53.5	73	J. N. N.
"	"	"	"		70	. 52	70	. 55	70 . 53.5		J. D. G.
"	"	W	W	9.00	71	. 40	71	. 35	71 . 37.5	74	J. N. N.
"	"	"	"		71	. 41	71	. 36.5	71 . 38.7		J. D. G.
"	"	W	E	9.07	71	. 01.5	70	. 56	70 . 58.2	74	J. N. N.
"	"	"	"		71	. 02.5	70	. 57	70 . 59.2		J. D. G.
"	"	E	W	9.12	71	. 32	71	. 37	71 . 34.5	74	J. N. N.
"	"	"	"		71	. 33	71	. 37	71 . 35		J. D. G.

Needle No. 2, gives, with marked end north,	71° 16'.26
with marked end south,	71° 24'.38

2. From the position of the instrument to the eastern iron gate, measured along the gravelled walk on whose south margin the instrument stands, is 261 feet.

No. of Needle.	Polarity of marked end of needle.	Face of Instrument.	Marked side of Needle.	Meansolar time of observation.	North end of Needle reads.	South end of Needle reads.	Mean of both ends of Needle.	Attached Thermometer. (Fahrenheit.)	Name of Observer.
				H. M.	Deg. Mins. & Tenths.	Deg Mins. & Tenths.	Deg. Mins. & Tenths.		
1	S	E	E	9.50 A.M.	70 . 32.5	70 . 36	70 . 34.2	75°	J. N. N.
"	"	"	"		70 . 31.5	70 . 35.5	70 . 33.5		J. D. G.
"	"	W	W	9.56	72 . 15	72 . 08	72 . 11.5	76	J. N. N.
"	"	"	"		72 . 16	72 . 08	72 . 12		J. D. G.
"	"	W	E	10.04	71 . 30	71 . 23	71 . 26.5	77	J. N. N.
"	"	"	"		71 . 30	71 . 24	71 . 27		J. D. G.
"	"	E	W	10.14	71 . 21	71 . 27	71 . 24	77	J. N. N.
"	"	"	"		71 . 21.5	71 . 26	71 . 23.7	77	J. D. G.
1	N	E	E	10.30	71 . 21	71 . 27	71 . 24.5	77.5	J. N. N.
"	"	"	"		71 . 21.5	71 . 26	71 . 23.7		J. D. G.
"	"	W	W	10.38	71 . 06	70 . 59	71 . 02.5		J. N. N.
"	"	"	"		71 . 06	71 . 00.5	71 . 03.2		J. D. G.
"	"	W	E	10.42	71 . 29	71 . 21	71 . 25	78	J. N. N.
"	"	"	"		71 . 28	71 . 22.5	71 . 25.2		J. D. G.
"	"	E	W	11.00	70 . 46.5	70 . 51	70 . 48.7	79	J. N. N.
"	"	"	"		70 . 46	70 . 51	70 . 48.5		J. D. G.

The close coincidence of the repeated readings of the needles of this instrument, in the various positions necessary for a complete result, induced Mr. Nicollet to express a wish that we should institute a comparison, by means of simultaneous observations, between the dip, as given by this instrument, and that given by his instrument, made by Robinson, of London. He accordingly sent to Baltimore for his instrument, to be brought to Washington by the next morning's early cars. It arrived early on the morning of June 5th, and we continued the observations, each using his own instrument, as follows, viz.:

OBSERVATIONS FOR THE DIP OF THE MAGNETIC NEEDLE, WITH INSTRUMENT BY GAMBEY, OF PARIS.

1841, June 5th.—Washington City, D. C. Same position as on the 4th, viz., under an elm-tree which is on the south margin of the northern middle avenue or gravelled walk, running east and west through this garden.

No. of Needle.	Polarity of marked end of Needle.	Face of Instrument.	Marked side of Needle.	Meansolar time of observation.	North end of Needle reads		South end of Needle reads		Mean of both ends of Needle.	Attached Thermometer. (Fahrenheit.)	Name of Observer.
				H. M.	Deg.	Mins. & Tenths.	Deg.	Mins. & Tenths.			
1	N	E	E	7.30 A.M.	71	. 18	71	. 21	71 . 19.5	73°	Maj. J. D. Graham.
"	"	"	"		71	. 20	71	. 23	71 . 21.5		
"	"	W	W	7.40	71	. 01	70	. 55	70 . 58	74	
"	"	"	"		71	. 02	70	. 56	70 . 59		
"	"	W	E	7.50	71	. 30	71	. 27	71 . 28.5	74	
"	"	"	"		71	. 31	71	. 24	71 . 27.5		
"	"	E	W	8.00	70	. 51	70	. 55.5	70 . 53.2	75	
"	"	"	"		70	. 51	70	. 55.5	70 . 53.2		
1	S	E	E	8.20	70	. 51	70	. 56	70 . 53.5	76	Maj. J. D. Graham.
"	"	"	"		70	. 51	70	. 56	70 . 53.5		
"	"	W	W	8.30	71	. 42	71	. 38	71 . 40	77	
"	"	"	"		71	. 43	71	. 38	71 . 40.5		
"	"	W	E	8.40	71	. 12.5	71	. 08	71 . 10.2	78	
"	"	"	"		71	. 13.5	71	. 08	71 . 10.7		
"	"	E	W	8.50	71	. 23.5	71	. 27	71 . 25.2	79	
"	"	"	"		71	. 23.5	71	. 27.5	71 . 25.5		

The position of Mr. Nicollet's instrument is seventy feet in a direction west and perpendicular to the magnetic meridian from my instrument. He is going on with his observations simultaneously with mine.

Needle No. 1 gives, with marked end north, 71° 10'.05
 with marked end south, 71° 17' 39
 Dip, by thirty-two observations on needle No. 1, 71° 13'.72

1841, June 5th.—Washington City, D. C. Same position.

2	N	E	E	9.35 A.M.	70	. 47	70	. 50.5	70 . 48.7	82°	Maj. J. D. Graham.
"	"	"	"		70	. 47	70	. 51	70 . 49		
"	"	W	W	9.55	71	. 41	71	. 35	71 . 38	84	
"	"	"	"		71	. 40	71	. 34	71 . 37		
"	"	W	E	10.00	71	. 01	70	. 56	70 . 58.5	86	
"	"	"	"		71	. 02.5	70	. 56.5	70 . 59.5		
"	"	E	W	10.08	71	. 28	71	. 33	71 . 30.5	86	
"	"	"	"		71	. 28.5	71	. 32.5	71 . 30.5		
2	S	E	E	10.25	71	. 15	71	. 20	71 . 17.5	86°	Maj. J. D. Graham.
"	"	"	"		71	. 15	71	. 19	71 . 17		
"	"	W	W	10.35	71	. 01.5	70	. 55	70 . 57.7	86	
"	"	"	"		71	. 00.5	70	. 55	70 . 57.2		
"	"	W	E	10.40	71	. 32.5	71	. 26	71 . 29.2	86	
"	"	"	"		71	. 32.5	71	. 26	71 . 29.2		
"	"	E	W	10.45	70	. 44.5	70	. 48	70 . 46.2	87	
"	"	"	"		70	. 43.7	70	. 48.5	70 . 46.1		

Needle No. 2 gives, with marked end north, 71° 13'.96

with marked end south, 71° 07'.51

Dip, by thirty-two observations on needle No. 2, 70° 10'.73

Dip, by thirty-two observations on needle No. 1, 71° 13'.72

1841, June 5th.—Dip, near the centre of the public garden, east of the

capitol, by a mean of both needles of Gambey, 71° 12'.22

Mr. Nicolle transcribed in my note-book, with his own hand, the result of his observations with his own instrument, and requested me, when I reported mine, to report his also. They are as follows, viz.:

OBSERVATIONS FOR THE DIP OF THE MAGNETIC NEEDLE, WITH INSTRUMENT BY ROBINSON,
OF LONDON.

Date and place of observation.—1841, June 5th.—Washington City. In the public garden east of the capitol, and occupying a point thirty-nine feet west of the centre of the garden, and seventy feet west of Major Graham's instrument.

No. of Needle.	Polarity of Marked end of Needle.	Face of Instrument	Marked side of Needle.	Meansolartime of observation.	Mean of both ends of Needle.	Attached Thermometer. (Fahrenheit.)	Name of Observer.			
				H. M.	Deg. Mins. & Tenths.					
1	N	E	E	7.10 A.M.	71 . 00	72°	Mr. J. N. Nicollet.			
"	"	W	W		71 . 18					
"	"	W	E		71 . 07					
"	"	E	W		71 . 18					
1	N	E	E		71 . 12			Mr. J. N. Nicollet.		
"	"	W	W		71 . 07					
"	"	W	E		71 . 21					
"	"	E	W		71 . 07					
1	S	E	E		71 . 30	77			Mr. J. N. Nicollet.	
"	"	W	W		71 . 05					
"	"	W	E		71 . 41					
"	"	E	W	8 . 30	71 . 00					
2	N	E	E	9 . 00	70 . 57.5	79				Mr. J. N. Nicollet.
"	"	W	W		71 . 34					
"	"	W	E		71 . 03.5					
"	"	E	W		71 . 34					
2	S	E	E		71 . 25.5		Mr. J. N. Nicollet.			
"	"	W	W		71 . 06.5					
"	"	W	E		71 . 30.5					
"	"	E	W	10 . 05	70 . 53.5					

NOTE.—Each observation recorded is a mean of three readings of each end of the needle.—J. N. N.”

“Having applied the magnets to this needle, intending to reverse the poles, it was suspended for observation, when it was found, that, through a mistake in applying the magnets, the poles were not reversed.—J. N. NICOLLET.”

Needle No. 1, with marked end north, gives, 71° 11'.25

with marked end south, gives, 71° 19'

Dip, by needle No. 1, 71° 15'.12

"Weather fine; light clouds near the horizon; light north-west wind."

XIII. FIRST STATION.

This station was chosen in the shady grove of oaks north of the Washington monument. The precise locality of the station is N. 5° E. by needle, and three hundred and sixty-three yards, by measurement, from the centre of the Washington monument.

June 9th.

NEEDLE No. 1.

Polarity of Marked end.	No. of Readings.	Time of Observation.	Temperature.	Dip observed.
S	16	1h. 07m. P. M.	94°.5	71° 54'.13
N	16	1 51 "	95	71° 42'.91

Dip by thirty-two observations on needle No. 1, 71° 48'.52

NEEDLE No. 2.

S	16	2h. 32m. P. M.	94°.5	71° 41'.65
N	16	2 59 "	94 .5	71° 55'.08

Dip, by thirty-two observations on needle No. 2, 71° 48'.36

Dip, by sixty-four observations on needles Nos. 1 and 2, 71° 48'.44

The weather was clear, with a gentle breeze from the west-north-west during the observations of this day.

1841, June 10th.—Same station.

NEEDLE No. 1.

N	16	6h. 47m., A. M.	72°	71° 42'.51
S	16	7 20 "	74	71° 54'.47

Dip, by thirty-two observations on needle No. 1, 71° 48'.49

NEEDLE No. 2.

N	16	8h. 07m., A. M.	76°.5	71° 50'.73
S	16	9 01 "	79	71° 36'.51

Dip, by thirty-two observations on needle No. 2, 71° 43'.62

Dip, by sixty-four observations on needles Nos. 1 and 2, made June

10, 1841. 71° 46'.05

XIV. Baltimore—second station.—June 10th, 1841.

In the second square north-east of the Washington monument, under a large white-oak tree, which bears S. 47° W., by the magnetic needle, and is distant one hundred and sixty-one feet by measurement from the curb-stone which marks the south-west corner of Calvert and Reed Streets. It is the largest tree in view on this hill, and affords ample shade.

NEEDLE No. 1.

S	16	11h. 41m., A. M.	85°	71° 37'.1
N	16	0 35 P. M.	86	71° 26'.46

Dip, by thirty-two observations of needle No. 1, 71° 31'.78

NEEDLE No. 2.

S	16	1h. 47m., P. M.	86°	71° 29'.63
N	16	2 20 "	86	71° 34'.73

Dip, by thirty-two observations on needle No. 2, 71° 32'.18

Dip, by sixty-four observations on needles Nos. 1 and 2, 71° 32'

Weather clear and fine. Almost calm.

NOTE.—The dip was observed at this station by Professor A. D. Bache, of Philadelphia, on the 27th of August, 1840, to be 71° 34'.4. See proceedings of Am. Phil. Soc., vol. i. p. 295.

The following magnetic bearings were observed from this tree, in order still farther to identify the position of this station, viz.:

From the tree, the Washington monument bears S. 45° W.

“ “ the steeple of St. Paul's Church bears S. 13° W.

“ “ the dome of the Exchange bears S. 14° E.

“ “ the most western shot-tower bears S. 18° E.

“ “ the most eastern shot-tower bears S. 33° E.

“ “ the white steeple of a distant church bears N. 82° E.

The bearings are given as observed with a good prismatic compass.

I now felt curious to ascertain what would be the change of dip at positions intermediate of stations one and two, and also if the needles would be affected at those two stations by a line of iron pipes, which I was informed lay at a depth of four feet under ground, along the margin of an intermediate drain or valley, for conducting the water from a neighbouring spring-house.

I accordingly chose two intermediate points between stations one and two, which are called the third and fourth Baltimore stations.

The following observations and measurements were made to show the relative positions of these four stations with respect to one another. The bearings are magnetic and were observed with a prismatic compass. The distances were measured with a surveyor's chain.

From the centre of the Washington Monument to station one is N. 5° E., and distance 1089 feet.

From station one to station three is S. 35° E., and distance 212 feet.

From station three to station four is S. 8° E., and distance 181 feet.

From station four to station two is N. 78° E., and distance 449 feet.

Station No. 3 is forty-three feet north of the line of iron pipes.

Station No. 4 is one hundred and thirty-seven feet south of the line of iron pipes.

XV. Baltimore—third station.—June 10th, 1841.

NEEDLE No. 1.

Polarity of Marked end of Needle.	No. of Readings	Time of Observation.	Temperature	Dip observed.
N	8	3h. 52m., P. M.,	87°.5	71° 41'.05
S	8	4 52 “	87	71° 54'.85

Dip, by 16 observations on needle No. 1, first set, 71° 47'.9

The observations were repeated with needle No. 1 at this station, and the readings of the needle were made by Mr. James Green, of Baltimore, as follows, viz.:

S	8	5h. 27m., P. M.	85°	71° 57'.25
N	9	5 49 “	86	71° 39'.75

Dip, by sixteen observations on needle No. 1, second set, . . . 71° 48'.5

Dip, by thirty-two observations on needle No. 1, being a mean of two sets of observations 71° 48'.2

XVI. Baltimore—fourth station.—June 10th, 1841.

NEEDLE No. 1.

N	8	6h. 46m., P. M.	80°	71° 45'.6
S	8	7 02 “	78	71° 55'.85

Dip, by sixteen observations on needle No. 1, 71° 55'.85

From the results at stations three and four, it appears that the needle was not influenced by the line of iron pipes, for such an influence would have given a less dip than at stations one and two, whereas a greater dip was in both cases obtained than that observed at either station one or station two.

Stations three and four are much below the level of one and two. The needles at those two stations being in closer proximity to the rocks forming the substratum here, a ferruginous sandstone, no doubt caused the great change of dip, by a slight change of position. The dip at these four stations is, indeed, in proportion to the depression of these stations, respectively, below a given horizontal plane. That is, the greatest dip is found at the least elevation above tide, and the least dip is found at the greatest elevation, and so on, in proportion to actual depression.

XVII. Baltimore—Fifth Station.—June 11th, 1841.

In the small observatory in the botanic garden of St. Mary's College. This observatory was erected for magnetic observations. It is built with copper nails, and there is no iron about it. Latitude $39^{\circ} 17' 55''$, N.; longitude $76^{\circ} 37' 30''$, W.

NEEDLE No. 1.

Polarity of Marked end.	No. of Readings.	Time of Observation.	Temperature.	Dip observed.
S	16	6h. 43m., A. M.	76°	71° 44'.71
N	16	7 04 “	77 .5	71° 33'.66
Dip, by thirty-two observations on needle No. 1,				71° 39'.18

NEEDLE No. 2.

N	16	7h. 20m., A. M.,	78°	71° 42'.43
S	16	7 39 “	80	71° 34'.7
Dip, by thirty-two observations on needle No. 2,				71° 38'.56
Dip, by sixty-four observations on needles Nos. 1 and 2,				71° 38'.87

A RECAPITULATION,

Showing the results of all the observations for the dip at the respective stations at Baltimore, on the 9th, 10th, and 11th of June, 1841.

- 1st. At station three hundred and sixty-three yards N. 5° E. of the Washington Monument, by a mean of one hundred and twenty-eight observations on needles Nos. 1 and 2, combined, June 9th and 10th, 71° 47'.24
- 2d. At station S. 47° W., and distant one hundred and sixty-one feet from the curb-stone which marks the south-west corner of Calvert and Reed Streets, in the city plan, by a mean of sixty-four observations on needles No. 1 and 2, combined, June 10th, 1841, 71° 32'
- 3d. At station S. 35° E., and two hundred and twelve feet from station No. 1, being forty-three feet north of line of iron pipes; by thirty-two observations, two series, on needle No. 1, June 10th, 1841, 71° 48'.2
- 4th. At station S. 8° E., and one hundred and eighty-one feet from station No. 2, being one hundred and thirty-seven feet south of line of iron pipes, by sixteen observations on needle No. 1, June 10, 1841, 71° 50'.7

5th. At the observatory in the botanic garden of St. Mary's College, by sixty-four observations on needles No. 1 and 2 combined, on the 11th of June, 1841, 71° 38'.87

Comparing the dip obtained by Professor Bache, at station No. 2, with two needles, on the 27th of August, 1840, namely, 71° 34'.4, with my result from sixty-four observations, on two needles, on the 10th of June, 1841, namely, 71° 32', we have, for an elapsed time of nine and a half months, a diminution of 2'.4, which is very near what might be expected in that lapse of time; and hence the agreement of the results obtained by two different observers, with different instruments, serves to confirm the accuracy of both.

Professor Loomis observed the dip in the grove north of the Washington Monument, Baltimore, with a single needle, on the 25th of September, 1839, to be 71° 50'.3.* But the precise locality of his station is not given. This is to be regretted, because it precludes any correct comparison with the results of other observers, and other instruments, made at after periods, for the purpose of ascertaining the periodical variation in the dip. This grove is an extensive one, and it has been shown, by the observations here presented, that a very little change of position in this grove produces a very sensible change in the dip. My stations 1, 2, 3, and 4, are all within this grove, which extends north and east of the Washington Monument. It is very desirable that all localities for magnetic observations be stated with precision, in reference to permanent and conspicuous objects.

XVIII. OBSERVATIONS FOR THE DIP OF THE MAGNETIC NEEDLE, WITH INSTRUMENT BY GAMBÉY, OF PARIS.

Date and place of observation.—1841, June 14th. At the magnetic Observatory of Girard College, Philadelphia.

No. of Needle.	Polarity of Marked end of Needle.	Face of Instrument.	Marked side of Needle.	Mean solar time of observation.	North end of Needle reads		South end of Needle reads		Mean of both ends of needle.	Attached Thermometer. (Fahrenheit.)	Name of Observer.
				H. M.	Deg.	Mins. & Tenths.	Deg.	Mins. & Tenths.			
1	N	E	E	4.36 P.M.	72	. 01	72	. 00	72 . 00.5	78°	A.D.B.
"	"	"	"		71	. 59	72	. 02	72 . 00.5		J. D.G.
"	"	"	"		71	. 59	72	. 02	72 . 00.5		A.D.B.
"	"	E	W	4.50	71	. 22	71	. 26	71 . 24	77.5	J. D.G.
"	"	"	"		71	. 24	71	. 28	71 . 26		A.D.B.
"	"	"	"		71	. 24	71	. 28	71 . 26		J. D.G.
"	"	W	E	5.00	72	. 19	72	. 12	72 . 15.5	75.5	A.D.B.
"	"	"	"		72	. 20	72	. 13	72 . 16.5		J. D.G.
"	"	"	"		72	. 18	72	. 14	72 . 16		A.D.B.
"	"	W	W	5.12	71	. 46	71	. 39	71 . 42.5	74.2	J. D.G.
"	"	"	"		71	. 46	71	. 37	71 . 41.5		A.D.B.
"	"	"	"		71	. 46	71	. 39.5	71 . 42.7		J. D.G.
1	S	W	W	5.35	72	. 19	72	. 10	72 . 14.5	72.7	A.D.B.
"	"	"	"		72	. 19	72	. 13	72 . 16		J. D.G.
"	"	"	"		72	. 16	72	. 08	72 . 12		A.D.B.
"	"	W	E	5.52	72	. 04	71	. 57	72 . 00.5	71.5	J. D.G.
"	"	"	"		72	. 03	71	. 56	71 . 59.5		A.D.B.
"	"	"	"		72	. 03	71	. 58	72 . 00.5		J. D.G.
"	"	E	W	6.00	71	. 59	72	. 03	72 . 01	71	A.D.B.
"	"	"	"		71	. 58	72	. 02	72 . 00		J. D.G.
"	"	"	"		71	. 59	72	. 03	72 . 01		A.D.B.
"	"	E	E	6.10	71	. 42	71	. 47	71 . 44.5	70	J. D.G.
"	"	"	"		71	. 39	71	. 45	71 . 42		A.D.B.
"	"	"	"	6.20	71	. 41	71	. 45	71 . 43		J. D.G.

* See Transactions of the American Philosophical Society, vol. vii., new series, page 108.

I was joined in the observations at this station by Professor Alexander D. Bache, President of Girard College. The needles were read by us alternately. The initials in the last column will show the observations made by each observer.

Raining all the time we were observing with needle No. 1.

Needle No. 1, gives, with marked end north, 71° 51'

with marked end south, 71° 59'.5

Dip, by forty-eight observations on needle No. 1, 71° 55'.25

1841, June 14th.—At the Magnetic Observatory of Girard College, Philadelphia.

No of Needle.	Polarity of marked end of needle.	Face of Instrument.	Marked side of Needle.	Meansolar time of observation.	North end of Needle reads.	South end of Needle reads.	Mean of both ends of Needle.	Attached Thermometer. (Fahrenheit.)	Name of Observer.
				H. M.	Deg. Mins. & Tenths.	Deg. Mins. & Tenths.			
2	S	E	E	6.25 P.M.	72.00	72.05	72.02.5	68°.5	J. D. G.
"	"	"	"		72.01	72.05	72.03		A. D. B.
"	"	"	"		72.02.5	72.06	72.04.2		J. D. G.
"	"	E	W	6.30	71.31	71.35	71.33		A. D. B.
"	"	"	"		71.27	71.32	71.29.5		J. D. G.
"	"	"	"		71.29	71.34	71.31.5		A. D. B.
"	"	W	E	6.34	72.20	72.14	72.17		J. D. G.
"	"	"	"		72.20	72.13	72.16.5		A. D. B.
"	"	"	"		72.20	72.13	72.16.5		J. D. G.
"	"	W	W	6.37	71.47	71.38	71.42.5		A. D. B.
"	"	"	"		71.44	71.37	71.40.5		J. D. G.
"	"	"	"		71.45	71.39	71.42		A. D. B.
2	N	W	W	6.57	72.21.5	72.14	72.17.7	68	J. D. G.
"	"	"	"		72.23	72.15	72.19		A. D. B.
"	"	"	"		72.23	72.15	72.19		J. D. G.
"	"	W	E	7.00	71.47	71.41	71.44		A. D. B.
"	"	"	"		71.47	71.40	71.43.5		J. D. G.
"	"	"	"		71.48	71.40	71.44		A. D. B.
"	"	E	W	7.05	72.03	72.07	72.05		J. D. G.
"	"	"	"		72.04	72.06	72.05		A. D. B.
"	"	"	"		72.02	72.06	72.04		J. D. G.
"	"	E	E	7.10	71.28	71.33	71.30.5		A. D. B.
"	"	"	"		71.27	71.32	71.29.5		J. D. G.
"	"	"	"		71.27	71.32	71.29.5		A. D. B.

Raining nearly all the time we were observing this day.

Needle No. 2, gives, with marked end north, 71° 54'.22

with marked end south, 71° 53'.22

Dip, by forty-eight observations on needle No. 2, 71° 53'.72

Dip, by forty-eight observations on needle No. 1, 71° 55'.25

Magnetic dip at the Magnetical Observatory of Girard College, Philadelphia,

by ninety-six observations on needles Nos. 1 and 2, June 14, 1841, 71° 54'.48

XIX. Cambridge Observatory, Massachusetts.

Latitude 42° 22' 21".3, N.; Longitude 71° 07' 37".5, W.

The station occupied was the marble table usually occupied by the variation Transit belonging to the Magnetic Department of the Observatory. This is the temporary observatory used until the permanent establishment shall be constructed.

I was joined in these observations by Wm. C. Bond, Esq., Director of the Cambridge

Observatory. We read the needles alternately, and a mean of all the observations, as made by us both, is given in the several results.

The close coincidence which had been remarked in the results of the two needles of this instrument, and the great uniformity in the readings of both in the various positions assumed for a course of observations, determined us to observe, without intermission, for twenty-four consecutive hours, with a view not only to a close determination of the dip at this station, but also to ascertain its diurnal variation.

1841, JUNE 29th.—NEEDLE No. 1.

Polarity of Marked end.	No. of Readings.	Time of Observation.	Temperature.	Dip observed.
S	24	8h. 49m., P.M.	82°.7	74° 20'.76
N	24	10 28 “	79.9	74° 11'.12

Dip, by forty-eight observations on needle No. 1, 74° 15'.94

1841, JUNE 30.—NEEDLE No. 2.

N	24	1h. 35m., A.M.	78°.9	74° 16'.47
S	24	3 12 “	78.8	74° 16'.11

Dip, by forty-eight observations on needle No. 2, 74° 16'.29

NEEDLE No. 2, REPEATED.

S	24	10h. 03m., A.M.	85°.5	74° 18'.82
N	24	11 14 “	88.5	74° 23'.28

Dip, by forty-eight observations on needle No. 2, second set, . . . 74° 21'.05

NEEDLE No. 1.

N	24	0h. 28m., P.M.	89°	74° 14'.65
S	24	1 38 “	92	74° 21'.86

Dip, by forty-eight observations on needle No. 1, second set, . . . 74° 18'.25

NEEDLE No. 1, REPEATED.

S	24	3h. 18m., P.M.	87°.5	74° 23'.5
N	24	4 20 “	84	74° 09'.45

Dip, by forty-eight observations on needle No. 1, third set, . . . 74° 16'.42

NEEDLE No. 2.—JUNE 30.

N	24	5h. 02m., P.M.	83°.5	74° 18'.13
S	24	6 18 “	81	74° 13'.53

Dip, by forty-eight observations on needle No. 2, third set, . . . 74° 15'.83

RECAPITULATION OF THE FOREGOING OBSERVATIONS AT CAMBRIDGE.

Date—1841.	No. of Needle.	Polarity of marked end of Needle.	Beginning of observations on each needle.	End of observations on each needle.	Mean of each set of readings.	Dip by each needle.
June 29,	1	{ S	8h.13m., P.M.	9h.25m., P.M.	74° 20'.76 }	74° 15'.94
		{ N	9 55 “	11 00 “	74° 11'.12 }	
June 30,	2	{ N	1h.12m., A.M.	1h.58m., A.M.	74° 16'.47 }	74° 16'.29
		{ S	2 50 “	3 34 “	74° 16'.11 }	
June 30,	2	{ S	9h.45m., A.M.	10h.22m., A.M.	74° 18'.82 }	74° 21'.05
		{ N	10 58 “	11 31 “	74° 23'.28 }	
June 30,	1	{ N	0h.07m., P.M.	0h.48m., P.M.	74° 14'.65 }	74° 18'.25
		{ S	1 21 “	1 55 “	74° 21'.86 }	
June 30,	1	{ S	2h.52m., P.M.	3h.44m., P.M.	74° 23'.5 }	74° 16'.47
		{ N	4 03 “	4 37 “	74° 09'.45 }	
June 30,	2	{ N	4h.48m., P.M.	5h.17m., P.M.	74° 18'.13 }	74° 15'.83
		{ S	5 58 “	6 38 “	74° 15'.83 }	

Dip, by one hundred and forty-four observations on needle No. 1, made
June the 29th and 30th, 1841, 74° 16'.88

Dip, by one hundred and forty-four observations on needle No. 2, made
June 30th, 1841, 74° 17'.72

Magnetic dip, by a mean of two hundred and eighty-eight observations, in-
cluding both needles, 74° 17'.3

NOTE.—A mean between the greatest and least dip obtained, being by two different needles, is 74° 18'.44.

A mean between both needles in the night, say from 8h. 13m., P. M., to 3h. 34m., A. M., the middle time being within seven minutes of midnight, is 74° 16'.11.

A mean between both needles in the day, say from 10h. 22m., A. M., to 1h. 55m., P. M., the middle time being eight minutes after noon, is 74° 19'.65.

A mean between the midnight and the mid-day results, as above, is 74° 17'.88.

XX. *Boston, July 2d, 1841.*

On the common or mall. The position of observation is two hundred and fifty feet east by south of the summit of the old redoubt, or battery hill, the instrument being under the shade of a small elm tree. Latitude 42° 21' 19'', N.; Longitude 71° 04' 12'', W.

NEEDLE No. 1.

Polarity of Marked end.	No. of Readings.	Time of Observation.	Temperature.	Dip observed.
N	24	7h. 13m., A. M.	68°	74° 03'.49
S	24	8 25 “	70	74° 13'.33

Dip, by forty-eight observations on needle No. 1, 74° 08'.41

NEEDLE No. 2.

S	24	9h. 29m., A. M.	70°.5	74° 08'.33
N	24	10 53 “	74	74° 12'.58

Dip, by forty-eight observations on needle No. 2, 74° 10'.45

Dip, by a mean of ninety-six observations on needles Nos. 1 and 2, 74° 09'.43

XXI. *Bangor, Maine, July 9th, 1841.*

In the vacant lot of Mr. A. M. Roberts. Latitude 44° 48', N.; Longitude 68° 47', W.

NEEDLE No. 1.

S	24	1h. 35m., P. M.	75°.5	76° 17'.41
N	24	2 38 “	75	76° 09'.14

Dip, by forty-eight observations on needle No. 1, 76° 13'.27

NEEDLE No. 2.

N	24	6h. 10m., P. M.	67°.5	76° 11'.89
S	24	6 57 “	65	76° 09'.71

Dip, by forty-eight observations on needle No. 2, 76° 10'.8

NEEDLE No. 1, REPEATED.

N	16	7h. 51m., P. M.	62°.5	76° 09'.27
S	8	8 26 “	62	76° 13'.87

Dip, by twenty-four observations on needle No. 1, second trial, 76° 11'.57

The late hour of the evening prevented more than eight readings on needle No. 1, with the polarity south, second set.

RECAPITULATION

Of the observations made at Bangor, Maine, July 9, 1841.

Magnetic dip, by forty-eight observations on needle No. 1, from 1 <i>h.</i> 15 <i>m.</i> , to 2 <i>h.</i> 52 <i>m.</i> , P. M.,	76° 13'.27
Magnetic dip, by twelve observations on the same needle, from 7 <i>h.</i> 43 <i>m.</i> , to 8 <i>h.</i> 35 <i>m.</i> , P. M.,	76° 11'.57
Dip, by sixty observations on needle No. 1,	76° 12'.4
“ forty-eight observations on needle No. 2,	76° 10'.8
Dip, by a mean of one hundred and eight observations on needles Nos. 1 and 2, made July 9th, 1841,	76° 11'.6

The weather was clear all day.

A small white-oak tree marks the position of the instrument. From it the following magnetic bearings were observed, of conspicuous objects, viz.:

To the steeple of the new Methodist Church, distant about 250 yards, S. 74° W.

To the dome of the Female Academy, S. 53° W.

To the centre of the state arsenal, N. 4° W.

The three bearings fix the point of observation independent of a measured distance, which could not conveniently be made here.

XXII. *Park's Hill, August 27th, 1841.*

Astronomical station No. 2, on the true meridian of the monument at the source of the river St. Croix. Boundary of Maine and New Brunswick. Latitude 46° 06' 40", N.; Longitude 67° 46' 45", W. Same station as XI. in the preceding series.

NEEDLE No. 1.

Polarity of Marked end.	No. of Readings.	Time of Observation.	Temperature.	Dip observed.
S	24	12 <i>h.</i> 00 <i>m.</i> , noon.	69°.5	77° 03'.82
N	24	00 51 A. M.	73 .5	76° 57'.74
Dip, by forty-eight observations on needle No. 1,				77° 00'.78

NEEDLE No. 2.

S	24	1 <i>h.</i> 51 <i>m.</i> , P. M.,	74°	76° 59'.29
N	24	2 48 “	75	77° 02'.14
Dip, by forty-eight observations on needle No. 2,				77° 00'.71
Dip, by a mean of ninety-six observations on needles Nos. 1 and 2,				77° 00'.74

The observations were made in the shade of the forest: the sun somewhat obscured by thin clouds: weather pleasant: wind south south-east: nearly calm.

NOTE.—On the 27th, 28th, and 29th of November, 1840, I observed the dip at this station with the instrument by Troughton & Simms, of London, which I had used on the Texan frontier. The result then obtained, with the needles numbered 3 and 4, was 70° 02'.5, differing 1'.8 from the result obtained now, with the Gambey instrument, in an elapsed period of nine months. See observation XI. of my preceding series.

The difference of these two results is probably not more than should be attributed to the diminution of the dip during the elapsed time between the two sets of observations, being at the rate of 2'.4 per annum. The results show a very satisfactory agreement in the two instruments, and seem to entitle the observations made on the Texan frontier and elsewhere, with the former instrument, to additional weight in regard to accuracy.

XXIII. *Blue Hill, New Brunswick.* 1841, *October 5th and 6th.*

At astronomical station No. 3, on the meridian of the monument at the source of the river St. Croix. Latitude $46^{\circ} 38'$, N.; Longitude $67^{\circ} 46' 45''$, W.

NEEDLE NO. 1.—OCTOBER 5.

Polarity of Marked end.	No. of Readings.	Time of Observation.	Temperature.	Dip observed.
N	16	4h. 11m., P. M.	47°	77° 15'.83
S	16	4 56 “	44	77° 19'.18
Dip, by thirty-two observations on needle No. 1,				77° 17'.5

NEEDLE NO. 2.—OCTOBER 5TH AND 6TH.

N	16	5h. 30m., P. M., Oct. 5	44°	77° 20'.5
S	16	10 59 A. M., Oct. 6	54	77° 17'.5
Dip, by thirty-two observations on needle No. 2, October 5th, P. M., and October 6th, A. M.,				77° 19'

NEEDLE NO. 2 AS OBSERVED ON WHOLLY ON THE 6TH OF OCTOBER.

S	16	10h. 59m. A. M.	54°	77° 17'.5
N	16	11 51 “	60	77° 19'.56
Dip, by thirty-two observations on needle No. 2, October 6th, . . .				77° 18'.53

RECAPITULATION.

Dip, by thirty-two observations on needle No. 1, October 5th, 1841, . . .	77° 17'.5
Dip, by forty-eight observations on needle No. 2, made on the 5th and 6th of October, 1841,	77° 18'.76
Dip, by eighty observations on needles Nos. 1 and 2, made October 5th and 6th, giving an equal weight to each needle,	77° 18'.1

XXIV. *Aroostook Hill, New Brunswick.* 1841, *October 29th.*

At astronomical station No. 4, on the true meridian of the monument at the source of the river St. Croix. Latitude $46^{\circ} 47'$, N.; Longitude $67^{\circ} 46' 45''$, W.

NEEDLE NO. 1.

S	16	2h. 23m., P. M.	34°	77° 27'.62
N	16	3 20 “	35	77° 22'.12
Dip, by thirty-two observations on needle No. 1,				77° 24'.87

NEEDLE NO. 2.

N	16	3h. 40m., P. M.	35°	77° 23'.37
S	16	4 06 “	34.5	77° 23'.37
Dip, by thirty-two observations on needle No. 2,				77° 23'.37
Dip, by sixty-four observations on needles Nos. 1 and 2,				77° 24'.1

Cloudy, and sometimes raining during the observations. Wind south and squally. A few flakes of snow fell before the observations were begun.

XXV. *Peconk Hill, New Brunswick.*

At astronomical station No. 5, on the meridian of the monument at the source of the river St. Croix. Latitude $46^{\circ} 59' 25''$, N.; Longitude $67^{\circ} 46' 45''$, W. 1841, November 28th.

NEEDLE No. 1.

Polarity of Marked end.	No. of Readings.	Time of Observation.	Temperature.	Dip observed.
N	16	0h. 06m., P. M.	26°	77° 30'.68
S	16	1 00 "	25 .5	77° 34'.81

Dip, by thirty-two observations on needle No. 1, 77° 32'.75

The wind north-east. The sky tolerably clear when needle No. 1 was observed on.

NEEDLE No. 2.

S	16	2h. 15m., P. M.	25°	77° 30'.65
N	16	3 11 "	24 .5	77° 32'.56

Dip, by thirty-two observations on needle No. 2, 77° 31'.6

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, . 77° 32'.17

A light north-east wind, and snowing a little when needle No. 2 was observed on. The observations were made under a tent, free from iron fixtures.

XXVI. *Grand Falls of the St. John, New Brunswick.*

Latitude 47° 02' 48".5, N.; Longitude 67° 44' 36", W. 1843, September 10th.

NEEDLE No. 1.

N	16	1h. 02m., P. M.	57°	77° 28'.3
S	16	2 01 "	59	77° 33'.6

Dip, by thirty-two observations on needle No. 1, 77° 30'.9

NEEDLE No. 2.

N	16	3h. 03m., P. M.	57°	77° 29'.6
S	16	4 10 "	60	77° 26'.7

Dip, by thirty-two observations on needle No. 2, 77° 28'.1

Dip, by sixty-four observations on needles Nos. 1 and 2, 77° 29'.5

The weather was clear and dry all day. A fresh south-west wind. Observed under a tent free from iron fixtures.

XXVII. *At the point of intersection of the north shore of the River St. John with the meridian of the monument at the source of the River St. Croix, as traced by Major Graham in 1840 and 1841.*

Latitude 47° 03' 47", N.; Longitude 67° 46' 45", W. 1843, September 11th.

NEEDLE No. 1.

S	16	11h. 57m., A. M.	67°	77° 34'.33
N	16	0 45 P. M.	65 .5	77° 29'.97

Dip, by thirty-two observations on needle No. 1, 77° 32'.15

NEEDLE No. 2.

S	16	1h. 37m., P. M.	65°.5	77° 29'.3
N	16	2 21 "	65	77° 30'.6

Dip, by thirty-two observations on needle No. 2, 77° 29'.95

Dip, by sixty-four observations on needles Nos. 1 and 2, 77° 31'.05

XXVIII. *At the Inn of Anselme Albert, (late the Widow Michean's,) south bank of the River St. John, Maine.*

Latitude $47^{\circ} 17' 20''$, N.; Longitude $68^{\circ} 27' 34''$, W. 1843,—September 16th and 17th.

NEEDLE No. 1—SEPTEMBER 16TH.

Polarity of Marked end.	No. of Readings.	Time of Observation.	Temperature.	Dip observed.
N	16	5h. 23m. P. M.	71°	$77^{\circ} 43'.5$
S	16	6 04 “	67 .5	$77^{\circ} 47'.3$

Dip, by thirty-two observations on needle No. 1, $77^{\circ} 45'.4$

NEEDLE No. 2,—SEPTEMBER 17TH.

N	16	11h. 31m. A. M.	68°	$77^{\circ} 45'.19$
S	16	0 29 P. M.	65	$77^{\circ} 42'.21$

Dip, by thirty-two observations on needle No. 2, $77^{\circ} 43'.7$

Dip, by sixty-four observations on needles Nos. 1 and 2, $77^{\circ} 44'.5$

NOTE.—The point of observation is six hundred and five feet below the front door of Anselme Albert's Inn, measured along the crest of the high bank of the river St. John, on a magnetic course of S. 20° E.

The weather was clear during the observations on needle No. 1, on the 16th. During the observations on needle No. 2, on the seventeenth, it was frequently raining. Sky entirely overcast with clouds all this day. Nearly calm.

XXIX. *Mouth of Fish River, Maine, military post of Fort Kent.*

Latitude $47^{\circ} 15' 14''.5$, N.; Longitude $68^{\circ} 35' 30''$, W. 1843,—September 18th.

NEEDLE No. 1.

S	16	1h. 25m., P. M.	$78^{\circ}.5$	$77^{\circ} 45'.55$
N	16	2 10 “	77 .5	$77^{\circ} 41'.81$

Dip, by thirty-two observations on needle No. 1, $77^{\circ} 43'.68$

NEEDLE No. 2.

S	16	3h. 14m., P. M.	$82^{\circ}.5$	$77^{\circ} 42'$
N	16	3 52 “	81	$77^{\circ} 43'.06$

Dip, by thirty-two observations on needle No. 2, $77^{\circ} 42'.53$

Dip, by sixty-four observations on needles Nos. 1 and 2, $77^{\circ} 43'.1$

Weather fair. A fresh breeze from the north-west.

NOTE.—The point of observation is immediately on the high bank of Fish River, and fifty feet above the extreme point of the angle formed by the junction of the left or western bank of Fish River, with the right or southern shore of the River St. John.

From this point to the north-west corner of the Block House of Fort Kent is S. 8° W., magnetic, and the distance is four hundred and eleven feet, by measurement.

XXX. 1843,—September 26th. *Mouth of St. Francis River.*

At astronomical station of 1842, near Hammond's barn, New Brunswick. Latitude $47^{\circ} 10' 57''.9$, N.; Longitude $68^{\circ} 53' 58''.5$, W.

NEEDLE No. 1.

N	16	0h. 06m., P. M.	54°	$77^{\circ} 43'.19$
S	16	0 51 P. M.	58 .5	$77^{\circ} 45'.21$

Dip, by thirty-two observations on needle No. 1, $77^{\circ} 44'.20$

NEEDLE No. 2.

Polarity of Marked end of Needle.	No. of Readings.	Time of Observation.	Temperature.	Dip observed.
N	16	1 <i>h.</i> 53 <i>m.</i> , P. M.	55°.5	77° 44'.46
S	16	2 40 “	57 .5	77° 41'.09

Dip, by thirty-two observations on needle No. 2, 77° 42'.77

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, . 77° 43'.48

In the observations of this station I was joined by Captain William Robinson of the Royal Engineers, British astronomer attached to the joint commission for the demarcation of the boundary under the treaty of Washington. We read the needles alternately, and the final result is a mean of our respective readings.

Slight rain, with occasional sunshine during the observations.

XXXI. 1843,—*October 2d. At the head of Lake Petteiquaggamac or Beau Lac, of the St. Francis River, Maine.*

The position of the instrument is immediately on the right bank of the river, near its entrance into this lake, and N. 55° E., by needle, and two hundred and five feet from the astronomical station of last year, at the head of this lake. Latitude 47° 22' 40'', N.; Longitude 69° 03' 21'', W.

NEEDLE No. 1.

S	16	9 <i>h.</i> 22 <i>m.</i> , A. M.,	49°	77° 47'.93
N	16	10 21 “	49	77° 45'.8

Dip, by thirty-two observations on needle No. 1, 77° 46'.85

NEEDLE No. 2.

S	16	11 <i>h.</i> 39 <i>m.</i> , A. M.	48°.5	77° 46'.15
N	16	0 33 P. M.	49	77° 48'.34

Dip, by thirty-two observations on needle No. 2, 77° 47'.2

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, . 77° 47'

Wind north-east and squally; raining during the observations. The instrument was well protected, by a good water-proof tent, free from any iron fixtures.

XXXII. 1843,—*October 4th. At the outlet of Lake Pohenagamook.*

At astronomical station No. 13, of the year 1842. Maine and Canada boundary. Latitude 47° 27' 33''.5, N.; Longitude 69° 13' 19'', W.

NEEDLE No. 1.

N	16	10 <i>h.</i> 28 <i>m.</i> , A. M.	48°	77° 47'.53
S	16	11 18 “	49 .5	77° 51'.53

Dip, by thirty-two observations on needle No. 1, 77° 49'.53

NEEDLE No. 2.

N	16	11 <i>h.</i> 55 <i>m.</i> , A. M.	52°	77° 50'.97
S	16	0 42 “	49 .5	77° 47'.00

Dip, by thirty-two observations on needle No. 2, 77° 48'.98

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, . 77° 49'.2

Cloudy, with frequent showers of rain. Wind north-west, fresh.

XXXIII. 1843,—*October 10th. Mouth of the Chimpassaoctuc, or Big Black River, a tributary of the River St. John, Maine.*

The point of observation is astronomical station No. 18, on a small island of the river St. John, opposite to the mouth of Big Black River. Latitude $46^{\circ} 57'$, N.; Longitude $69^{\circ} 26' 46''$, W.

NEEDLE No. 1.

Polarity of Marked end.	No. of Readings.	Time of Observation.	Temperature.	Dip observed.
S	16	11h. 57m., A. M.	59°	77° 39'.22
N	16	0 48 P. M.	58 .5	77° 35'.12

Dip, by thirty-two observations on needle No. 1, 77° 37'.17

NEEDLE No. 2.

S	16	1h. 25m., P. M.	59°	77° 36'.56
N	16	2 15 “	58 .5	77° 39'.12

Dip, by a mean of thirty-two observations on needle No. 2, . . . 77° 37'.84

Dip, by a mean of sixty-four observations on needles No. 1 and 2, . 77° 37'.5

Cloudy, and occasionally a sprinkle of rain. Wind easterly and light.

XXXIV. 1843,—*October 17th. Near the Grand Forks of the River St. John.*

The point of observation is the astronomical station, where the line of ten miles, measured in the shortest direction from the North-West Branch, touches the river St. John. Latitude $46^{\circ} 34' 37''$, N.; Longitude $69^{\circ} 53' 00''$, W.

NEEDLE No. 1.

N	16	0h. 17m., P. M.	51°.5	77° 23'.43
S	16	1 15 “	50	77° 28'.15

Dip, by thirty-two observations on needle No. 1, 77° 25'.79

NEEDLE No. 2.

N	16	2h. 02m., P. M.	48°.5	77° 26'.34
S	16	2 51 “	47 .5	77° 25'.84

Dip, by thirty-two observations on needle No. 2, 77° 26'.09

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, . 77° 25'.94

Cloudy. Occasional sunshine during the observations. Wind westerly.

XXXV. *October 29th, 1843. At the mouth of the Madawaska River, a tributary of the St. John, New Brunswick.*

Latitude $47^{\circ} 21' 39''$, N.; Longitude $68^{\circ} 19' 25''$, W.

NEEDLE No. 1.

S	16	1h. 32m., P. M.	50°.5	77° 48'.34
N	16	2 32 “	44 .5	77° 46'.15

Dip, by thirty-two observations on needle No. 1, 77° 47'.24

NEEDLE No. 2.

S	16	2h. 59m., P. M.	43°	77° 45'.25
N	16	4 44 “	40 .5	77° 50'.18

Dip, by thirty-two observations on needle No. 2, 77° 47'.71

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, . 77° 47'.47

Cloudy; wind north-east; nearly calm. Light rain and mist during part of the observations on needle No. 2.

The point of observation is the intersection of the eastern shore of the Madawaska with the north shore of the St. John River.

XXXVI. 1844,—*May 2d. Portsmouth, New Hampshire.*

On Jamaica Island, near its north-western shore, in the hay-field of Mr. Isaias Preble. Latitude $43^{\circ} 04' 56''$, N.; Longitude $70^{\circ} 43' 56''$, W.

NEEDLE No. 1.

Polarity of Marked end	No. of Readings	Time of Observation.	Temperature.	Dip observed.
S	16	0h. 16m., P. M.	73°.5	74° 49'.62
N	16	0 59 "	74	74° 45'.59

Dip by thirty-two observations on needle No. 1, 74° 47'.6

NEEDLE No. 2.

S	16	1h. 42m., P. M.	72°.5	74° 47'.93
N	16	2 21 "	73	74° 47'.53

Dip, by thirty-two observations on needle No. 2, 74° 47'.73

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, . 74° 47'.66

Sky somewhat overcast. Fresh breeze from west-south-west.

NOTE.—In the observations at this and the succeeding four stations at and near Portsmouth, I was assisted by Lieutenant Whipple, of the Corps of Topographical Engineers attached to the survey for the defences of the harbour. I am indebted to him for the latitudes and longitudes of the actual positions of observation, which were derived by him from an accurate triangulation made to connect them all, in latitude and longitude, with the Unitarian stone Church, whose position was taken as given in the American Almanac, as in latitude $43^{\circ} 04' 35''$, N.; and longitude $70^{\circ} 45' 50''$, W. of Greenwich.

XXXVII. 1844,—*May 2d. Portsmouth, New Hampshire.*

The point of observation is eighty feet on a magnetic course of S. $68^{\circ} 30'$ W. from the northern extremity of Captain Stansbury's base line for the trigonometrical survey of the harbour of Portsmouth, and is in Latitude $43^{\circ} 02' 59''$, N.; Longitude $70^{\circ} 43' 36''$, W.

NEEDLE No. 1.

N	16	5h. 03m., P. M.	75°.5	74° 35'.25
S	16	5 32 "	73 .5	74° 39'.48

Dip, by thirty-two observations on needle No. 1, 74° 37'.36

NEEDLE No. 2.

N	16	5h. 52m., P. M.	73°	74° 38'.97
S	16	6 15 "	72	74° 38'.43

Dip, by thirty-two observations on needle No. 2, 74° 38'.7

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, . 74° 38'.03

Weather fair. Strong wind from the west-south-west.

XXXVIII. 1844,—*May 3d. Portsmouth, New Hampshire.*

The point of observation is in Mr. Robert Shelliby's pasture field. The instrument stands on a knoll twenty paces from a lonely black wild cherry tree, two feet in diameter

at its base. From this point the house of the Hon. Levi Woodbury is about three hundred feet in a north-easterly direction. Latitude $43^{\circ} 04' 27''$, N.; Longitude $70^{\circ} 46' 36''$, W

NEEDLE No. 1.

Polarity of Marked end.	No. of Readings.	Time of Observation.	Temperature.	Dip observed.
S	16	11h. 18m., A. M.	80°	74° 57'.15
N	16	11 49 “	79	74° 53'.28

Dip, by thirty-two observations on needle No. 1, 74° 55'.21

NEEDLE No. 2.

S	16	0h. 14m., P. M.	78°	74° 52'.03
N	16	0 43 “	78	74° 52'.34

Dip, by thirty-two observations on needle No. 2, 74° 52'.18

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, 74° 53'.7

Weather clear and pleasant. A fresh south-west wind.

XXXIX. May 3d, 1844.—*Portsmouth, New Hampshire.*

On Shapley's Point, being the southern extremity of Shapley's Island, four paces west of the trigonometrical station on this island. Latitude $43^{\circ} 04' 10''.5$, N.; Longitude $70^{\circ} 44' 48''$, W.

NEEDLE No. 1.

N	16	3h. 02m., P. M.	67°	74° 55'.43
S	16	3 32 “	66	74° 60'.31

Dip, by thirty-two observations on needle No. 1, 74° 57'.87

NEEDLE No. 2.

N	16	4h. 02m., P. M.	66°	74° 59'.90
S	16	4 32 “	66	74° 57'.15

Dip, by thirty-two observations on needle No. 2, 74° 58'.52

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, 74° 58'.2

Weather clear and pleasant. Strong south-west breeze.

XL. May 4th, 1844.—*Portsmouth, New Hampshire.*

On “One Tree Island,” a small island about one-fourth of an acre in area, opposite to Union Wharf. Latitude $43^{\circ} 04' 40''$, N.; Longitude $70^{\circ} 45' 17''$, W.

NOTE.—This is a very eligible position for magnetic observations, being very accessible from the city, and remote from any apparent cause of disturbance of the needle.

NEEDLE No. 1.

S	16	0h. 50m., P. M.	59°.5	74° 58'.68
N	16	1 28 “	57	74° 56'.28

Dip, by thirty-two observations on needle No. 1, 74° 57'.48

NEEDLE No. 2.

S	16	2h. 01m., P. M.	55°.5	74° 53'.68
N	16	2 35 “	56	74° 60'.87

Dip, by thirty-two observations on needle No. 2, 74° 57'.27

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, 74° 57'.37

Weather clear and pleasant. A moderate south-west breeze.

All the observations at Portsmouth were made under a tent, with fixtures devoid of iron.

XLI. *May 10th, 1844.—Philadelphia.*

Rittenhouse Square. The position of the instrument is the most western point of the circular gravelled walk which surrounds the centre grass plat of this square. A wooden fence at this time encloses the square. At the centre point of the square is an iron water pipe and plug which obliged me to occupy a point without its influence upon the needles. Latitude $39^{\circ} 56' 59''$; Longitude $75^{\circ} 10' 43''.5$.

NEEDLE No. 1.

Polarity of Marked end	No. of Readings.	Time of Observation.	Temperature.	Dip observed.
N	16	6h. 57m., A. M.	57°	72° 06'
S	16	7 47 “	62	72° 10'

Dip, by thirty-two observations on needle No. 1, 72° 08'

NEEDLE No. 2.

N	16	8h. 58m., A. M.	62°.5	72° 11'.12
S	16	9 38 “	64 .5	72° 09'.75

Dip, by thirty-two observations on needle No. 2, 72° 10'.43

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, 72° 09'.2

Weather clear and pleasant, with a gentle easterly breeze during the observations. The instrument was well shaded by trees.

NOTE.—This square affords a very eligible position for magnetic observations. Its centre is sufficiently remote from buildings and all cause of extraneous influence upon the needles. The trees within the square afford good shade for the instrument, and if the observer choose an early hour of the morning for his observations, there is no danger of any interruption from a crowd.

XLII. 1844, *July 8th.—Washington City, District of Columbia.*

Near the centre of the public garden, immediately east of the capitol. This is the same station as XII., where I observed the dip with the same instrument and needles on the 1st, 4th, and 5th of June, 1841. Latitude $38^{\circ} 53' 30''$, N.; Longitude $77^{\circ} 01' 30''$, W

NEEDLE No. 1.

S	16	6h. 23m., A. M.	66°	71° 13'.34
N	16	7 17 “	70	71° 09'.15

Dip, by thirty-two observations on needle No. 1, 71° 11'.24

NEEDLE No. 2.

S	16	8h. 05m., A. M.	74°	71° 06'.28
N	16	8 56 “	76	71° 13'.47

Dip, by thirty-two observations on needle No. 2, 71° 09'.87

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, 71° 10'.55

Weather fair and pleasant. A very gentle wind from east-north-east.

The dip, by a mean of one hundred and ninety-two observations, with this instrument, using the same needles as now, was observed on the 1st, 4th, and 5th of June, 1841, by Mr. J. N. Nicollet and myself to be $71^{\circ} 15'.9$, Mr. Nicollet having joined in those of

the 4th. And the dip obtained by Mr. Nicollet with his instrument, by Robinson of London, from a mean of one hundred and twenty observations, made on the 5th of June, 1841, was $71^{\circ} 15'.4$. Giving value to the observations of that period in proportion to the number of observations made with each instrument, we may state the dip at Washington, June 1st to 5th, 1841, to be, $71^{\circ} 15'.7$, and at the same place, on July 8th, 1844, $71^{\circ} 10'.5$. Decrease, in three and one-tenth years, $5'.2$, or at the rate of $1'.67$ per annum.

XLIII. 1844, *July 15th.*—*Baltimore.*

At the second Baltimore station, in the series of the year 1841; namely, one hundred and sixty-one feet on a magnetic course of $S. 47^{\circ} W.$ from the curb-stone which marks the south-west corner of Calvert and Reed Streets.

NEEDLE No. 1.

Polarity of Marked end.	No. of Readings.	Time of Observation.	Temperature.	Dip observed.
N	16	2h. 12m., P. M.	$88^{\circ}.5$	$71^{\circ} 29'.5$
S	16	2 52 "	89	$71^{\circ} 35'.9$

Dip, by thirty-two observations on needle No. 1, $71^{\circ} 32'.7$

NEEDLE No. 2.

N	16	3h. 43m., P. M.	89°	$71^{\circ} 35'.84$
S	16	4 23 "	$88^{\circ}.5$	$71^{\circ} 28'.93$

Dip, by thirty-two observations on needle No. 2, $71^{\circ} 32'.38$

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, $71^{\circ} 32'.54$

Weather clear. A gentle southerly breeze.

I obtained, for the dip at this station, by sixty-four observations on the same needles, with the same instrument, on June 10th, 1841, $71^{\circ} 32'$. See No. XIV. (page 354.)

Both sets of observations were quite satisfactory, and all the circumstances under which the two sets were made were equally favourable, and very similar. The temperature was nearly the same, so that no sensible correction is due, on that ground, to either set, for comparing it with the other. The difference in the dip obtained after a lapse of three years and thirty-six days, is only half a minute at this station, and the more recent observations give the greater dip. This may seem anomalous, but I have no reason to doubt the accuracy of either of the results. No buildings have been erected near the station since the first observations were made, nor is there any visible change of local circumstance whatever, that could have affected the dip.

XLIV. 1844, *July 16th.*—*Baltimore.*

Observatory of St. Mary's College, being the same station as No. XVII. Latitude $39^{\circ} 17' 55''$, N.; Longitude $76^{\circ} 37' 30''$, W.

NEEDLE No. 1.

S	16	8h. 12m., A. M.	83°	$71^{\circ}.42'.75$
N	16	8 44 "	85	$71^{\circ} 36'.51$

Dip, by thirty-two observations on needle No. 1, $71^{\circ} 39'.63$

NEEDLE No. 2.				
Polarity of Marked end.	No. of Readings.	Time of Observation.	Temperature.	Dip observed
S	16	9h. 09m., A. M.	86°.5	71° 36'.12
N	16	9 42 "	88	71° 42'.81

Dip, by thirty-two observations on needle No. 2, 71° 39'.46

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, 71° 39'.54

Weather clear and pleasant.

I obtained, for the dip at this station, by sixty-four observations on the same needles, and with the same apparatus in all respects, on June 11th, 1841, 71° 38'.87. See No. XVII., page 356.

Here again, at another station within the same city, the increase of dip, during a lapse of three years and thirty-six days, seems only to have amounted to two-thirds of a minute. No circumstance attending the observations nor change of local circumstance as respects the station, since the first observations were made, could be perceived, that could affect the dip.

XLV. 1844, *July 22d.*—*City of New York.*

Centre of Washington Square.

NEEDLE No. 1.				
N	16	6h. 01m., A. M.	67°	72° 29'.62
S	16	7 15 "	71	72° 32'.34

Dip, by thirty-two observations on needle No. 1, 72° 30'.98

NEEDLE No. 2.				
N	16	8h. 17m., A. M.	74°	72° 29'.75
S	16	9 15 "	77.5	72° 23'.84

Dip, by thirty-two observations on needle No. 2. 72° 26'.79

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, 72° 28'.88

Weather clear and dry. A very gentle breeze from the west.

The length of time occupied in these observations was owing to interruptions from idle spectators. Care was taken not to read the needles whilst any one was near enough to them to affect them, in case there was metal about his person, such as knives, keys, &c.

XLVI. 1844, *August 5th.*—*Forks of the Kennebec, Maine.*

Latitude of point of observation 45° 20' 03'', N.; Longitude 69° 58' 16'', W.

NEEDLE No. 1.				
S	16	6h. 32m., P. M.	67°	76° 23'.78
N	16	7 05 "	61.5	76° 22'.78

Dip, by thirty-two observations on needle No. 1, 76° 23'.28

NEEDLE No. 2.				
S	16	7h. 33m. P. M.	58°	76° 22'.94
N	16	8 00 "	55.5	76° 25'.40

Dip, by thirty-two observations on needle No. 2, 76° 24'.17

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, 76° 23'.7

Weather clear and calm.

NOTE.—From the front door of Burnham's Inn, near the east end of the bridge above the forks of the Kennebec river, to the point of observation, is S. 25° W., compared with the true meridian, or S. 38° W., magnetic, and the distance, by measurement, four hundred and ninety feet.

XLVII. 1844,—*August 7th.—Taschereau's. Intersection of the Highland Boundary with the Quebec road. Maine and Canada line.*

Latitude of point of observation N. $45^{\circ} 48' 37''.7$; Longitude of do. W. $70^{\circ} 24' 07''$.

NEEDLE No. 1.

Polarity of Marked end.	No. of Readings.	Time of Observation.	Temperature.	Dip observed.
N	16	6h. 08m., P. M.	56°	$76^{\circ} 48'.44$
S	16	6 39 “	58	$76^{\circ} 51'.12$

Dip, by thirty-two observations on needle No. 1, $76^{\circ} 49'.78$

NEEDLE No. 2.

N	16	6h. 55m., P. M.	58°	$76^{\circ} 52'.56$
S	16	7 34 “	56	$76^{\circ} 49'.59$

Dip, by thirty-two observations on needle No. 2, $77^{\circ} 51'.07$

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, $76^{\circ} 50'.42$

Raining, during the observations on both needles. The instrument was protected by a tent, free from any iron fixtures.

NOTE.—The point of observation is on the summit of the ridge of Highlands, and bears, from the front door of Taschereau's house, by the magnetic needle, N. $57^{\circ} 30'$ E., and is distant, by measurement, three hundred and twenty-five feet.

XLVIII. 1844,—*August 11th. Moose River Post Office, Maine.*

Latitude of point of observation $45^{\circ} 39' 22''$, N.; Longitude $70^{\circ} 16' 08''$, W.

NEEDLE No. 1.

S	16	6h. 28m., A. M.	$55^{\circ}.5$	$76^{\circ} 50'.3$
N	16	7 16 “	57	$76^{\circ} 47'.5$

Dip, by thirty-two observations on needle No. 1, $76^{\circ} 48'.9$

NEEDLE No. 2.

S	16	7h. 33m., A. M.	57°	$76^{\circ} 46'.5$
N	16	8 00 “	57	$76^{\circ} 49'.93$

Dip, by thirty-two observations on needle No. 2, $76^{\circ} 48'.2$

Dip, by a mean of sixty-four observations on needles Nos. 1 and 2, $76^{\circ} 48'.5$

The morning was clear and dry, with a stiff west breeze.

NOTE.—The point of observation is in the hay-field of Mr. Jacob Lowell, on the hill north-east of his house, and about ninety yards to the east of the public road. From the point of observation to the south-east corner of Mr. J. Lowell's house is S. 28° W., by needle, and the distance, by measurement, is six hundred and sixty-four feet.

XLIX. 1844, *September 1st.—Mouth of Grand River, New Brunswick.*

Latitude $47^{\circ} 11' 04''$, N.; Longitude $67^{\circ} 57' 18''$, W. The point of observation is the astronomical station at the mouth of the river, and is the north-east point of land at the junction of the east shore of Grand River with the north shore of the St. John.

NEEDLE No. 1.

Polarity of Marked end	No. of Readings.	Time of Observation.	Temperature	Dip observed
N	16	9h. 56m., A. M.	70°	77° 37'.03
S	16	10 30 "	75	77° 39'.16
Dip, by thirty-two observations on needle No. 1,				77° 38'.10

NEEDLE No. 2.

N	16	10h. 48m., A. M.	79°.5	77° 41'.12
S	16	11 23 "	82	77° 36'.12
Dip, by thirty-two observations on needle No. 2,				77° 38'.62
Dip, by a mean of sixty-four observations on needles Nos. 1 and 2,				77° 38'.36
Weather clear.				

L. 1844, *September 5th.*—*Mouth of Little Black River, Maine.*

Latitude 47° 06' 58", N.; Longitude 69° 05' 27", W. The station is the same as the astronomical station of 1843 and 1844, and is at the extremity of the point of land formed by the junction of the eastern shore of Little Black River with the north shore of the river St. John.

NEEDLE No. 1.

S	16	3h. 54m., P. M.	75°.5	77° 42'.53
N	16	4 24 "	71 .5	77° 37'.97
Dip by thirty-two observations on needle No. 1,				77° 40'.25

NEEDLE No. 2.

S	16	4h. 44m., P. M.	71°	77° 38'.53
N	16	5 17 "	72	77° 42'.97
Dip, by thirty-two observations on needle No. 2,				77° 40'.75
Dip, by a mean of sixty-four observations on needles Nos. 1 and 2,				77° 40'.5
Weather clear and dry, with a gentle north-west wind.				

LI. 1844, *November 9th.*—*South-west Branch of the St. John.*

At its intersection with the straight line of boundary. Maine and Canada line. Latitude 46° 25' 00", N.; Longitude 70° 03' 45", W.

NEEDLE No. 1.

N	16	9h. 34m., A. M.	32°.5	77° 23'.5
S	16	10 10 "	33 .5	77° 26'.03
Dip, by thirty-two observations on needle No. 1,				77° 24'.76

There was not time to make a satisfactory set of observations on needle No. 2. When the above were finished we left this station.

Weather cloudy. Occasionally a slight fall of snow. The snow is now two feet deep upon the ground.

The instrument was placed on the stand, (the trunk of a tree sunk four feet into the ground,) lately occupied by the altitude and azimuth instrument used for determining the latitude of this position, over which was a tent free from iron in any shape.

LII. *Cambridge Observatory, Massachusetts.*

Erected in the year 1844. Latitude $42^{\circ} 22' 48''.6$, N.; Longitude $71^{\circ} 08' 00''$, W. The point of observation is within the small magnetic pavilion attached to this observatory.

The position is not the same as is reported under the No. XIX., (see page 357,) where observations were made of the dip by Mr. W. C. Bond and myself, with the same apparatus, on the 29th and 30th of June, 1841. The position occupied for those observations was the *temporary* observatory at Cambridge, in latitude $42^{\circ} 22' 21''.3$, N.; and longitude $71^{\circ} 07' 37''.5$, W., which was used both for astronomical and magnetic purposes, previous to the construction of the present permanent establishment. The change of position seems to have caused but a slight change in the dip.

I regretted that other duties prevented Mr. Bond from joining me in the observations, with this instrument, on the present occasion. I am, however, much indebted to him for having, very kindly, placed at my disposal all the necessary conveniences of the observatory.—1844, December 23d.

NEEDLE No. 1.

Polarity of Marked end.	No. of Readings.	Time of Observation.	Temperature.	Dip observed.
S	16	1h. 00m. P. M.	45°	74° 19'.2
N	16	1 56 “	44	74° 16'
Dip by thirty-two observations on needle No. 1,				74° 17'.6

NEEDLE No. 2.

S	16	3h. 20m. P. M.	43°	74° 18'.6
N	16	4 20 “	43	74° 19'
Dip, by thirty-two observations on needle No. 2,				74° 18'.8
Dip, by sixty-four observations on needles Nos. 1 and 2,				74° 18'.2

Foggy, and nearly calm, during the observations on needle No. 1.

Fog and rain, during the observations on needle No. 2. Wind from north-east.

Barometer 28.89 inches, being very low for this locality.

J. D. GRAHAM.

Continuation of Major Graham's Paper. Read April 17th, 1846.

The following table (A) exhibits the results of the observations made at Rouse's Point, state of New York, on the 15th, 16th, 17th, and 18th of October, 1845, by Major Graham and Lieutenant Whipple, of the United States Corps of Topographical Engineers, for the dip of the magnetic needle, in the plane of the magnetic meridian, and in different azimuths.

The instrument used was made by Gambey of Paris, and has already been described.

The object of these observations was to test the accuracy of form of the axles of the needles, the freedom of the dip-circle from magnetism and ferruginous matter, and to ascertain the true dip from the observations made with the plane of the dip-circle, both in and out of the magnetic meridian.

In this table, column ten shows the equivalent dip for the plane of the magnetic meridian, deduced from each azimuthal observation, by the formula

$$\text{Cotan. } \delta = \frac{\text{Cotan. } \delta'}{\text{Cosin } \theta},$$

In which θ represents the azimuth observed in, δ' the dip observed in said azimuth, and δ the equivalent dip when reduced to the plane of the magnetic meridian.

The several values of δ , thus deduced, are compared directly with the dip as it was actually observed in the plane of the magnetic meridian, by means of ninety-six observations on the two needles, which give $76^{\circ} 40'.419$ for the dip.

Inasmuch, however, as a very small error of observation at a large azimuth, (say at 60° , 70° , or 80° from the plane of the magnetic meridian,) would make a great difference in the value of δ as derived from computation, and thus show a discrepancy due, not to the form of the axle or to magnetism in the circle, but to the error of reading the needle combined with any small error that might exist in the division of the azimuthal circle, or in setting the vernier to the stated azimuth, it has been thought proper to institute likewise a comparison between the dips, as actually observed in the various azimuths, and the computed azimuthal dips, assuming δ to be equal to the dip actually observed in the plane of the magnetic meridian.

Hence, δ' *observed*, column seven, is compared directly with δ'' , column eight, computed by transposing the terms of the formula so as to make

$$\text{Cotan. } \delta'' = \text{Cotan. } \delta. \text{Cosin } \theta.$$

Column nine shows the difference in *minutes* and *decimals of minutes*, + or —, between δ' and δ'' for each azimuth observed in, and the quantities in this ninth column are considered as exhibiting a truer index of the accuracy of form of the axles of the needles than would be derived from a comparison of the several deduced values of δ contained in column ten.

A

LIII. *Observations on the Dip of the magnetic needle made in the plane of the magnetic meridian, and also in various azimuths, at every 10°, from 0° to 90°, (by turning the vernier of the upper azimuth plate from the magnetic north round to the magnetic west,) made with Major Graham's dip instrument, by Gambey of Paris.*

STATION.—The astronomical observatory of the Boundary Survey, at Rouse's Point, state of New York, in Latitude 45° 00' 28", N.; Longitude 4h. 53m. 25s. west of Greenwich.

OBSERVERS.—Major J. D. Graham and Lieutenant A. W. Whipple, United States Corps of Topographical Engineers.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Date.	Mean solar time of observation.	Magnetic azimuth of plane of dip-circle.	No. of Needle.	Polarity of marked end of needle.	Dip observed in azimuth by each needle.	Dip in azimuth by observation.	Computed dip in azimuth.	Excess of computed over observed dip in various azimuths.	Dip reduced to plane of the magnetic meridian by each needle.	No. of observations.	Thermometer.	Barometer.	Remarks.
1845.													
Oct. 15.	0h. 38m., P. M.	0° & 180°	1	N	76° 39'.43	76° 39'.998			76° 39'.998	32	43°.1	30.216	Weather clear, and a stiff N.W. wind during the observations on both needles on the 15th. Cloudy, strong wind from S.
" "	1h. 44m., P. M.	0° & 180°	2	S	76° 40'.56					64	43°.1	30.221	
Oct. 18.	11h. 02m., A. M.	0° & 180°	2	N	76° 41'.37						52°	30.096	
				S	76° 37'.91	76° 39'.65							
				N	76° 43'.91	76° 42'.03							
				S	76° 40'.15								
Dip observed in the plane of the magnetic meridian, by a mean of the results of the two needles, (number of observations, ninety-six,) 76° 40'.419													
		θ				δ'	δ''		δ				
Oct. 16.	8h. 05m., A. M.	10° & 190°	1	N	76° 52'.84	76° 52'.1	76° 52'.14	+0'.04	76° 40'.36	32	30°.5	30.350	Weather clear; fresh S. W. wind during the observations this day.
" "	9h. 03m., A. M.	20° & 200°	1	S	76° 51'.36	77° 28'.62	77° 27'.07	-1'.55	76° 42'.06	32	33°.2	30.350	
" "	10h. 01m., A. M.	30° & 210°	1	N	77° 26'.47	78° 25'.06	78° 24'.23	-0'.83	76° 41'.13	32	35°.2	30.350	
" "	10h. 55m., A. M.	40° & 220°	1	S	77° 30'.78	79° 42'.95	79° 42'.91	-0'.04	76° 40'.46	32	37°	30.350	
" "	11h. 46m., A. M.	50° & 230°	1	N	78° 26'.09	81° 20'.59	81° 20'.55	-0'.04	76° 40'.46	32	38°.5	30.350	
" "	1h. 04m., P. M.	60° & 240°	1	S	78° 24'.03	83° 14'.60	83° 14'.73	+0'.13	76° 40'.17	32	41°.25	30.350	
" "	2h. 30m., P. M.	70° & 250°	1	N	79° 41'.40	85° 23'.78	85° 22'.09	-1'.69	76° 45'.13	32	43°	30.350	
" "	3h. 32m., P. M.	80° & 260°	1	S	79° 44'.50	87° 40'.4	87° 38'.67	-1'.73	76° 49'.85	32	44°.5	30.347	
" 18.	3h. 53m., P. M.	90° & 270°	1	N	81° 22'.50	89° 59'.48	90° 00'	+0'.52		32	55°.7	30.340	
				S	81° 18'.68								
				N	83° 13'.56								
				S	83° 15'.65								
				N	85° 24'.97								
				S	85° 22'.59								
				N	87° 40'.59								
				S	87° 40'.22								
				N	89° 59'.25								
				S	89° 59'.70								
Dip, by two hundred and fifty-six observations on needle No. 1, observed in the various azimuths stated in column three, and reduced by computation to the plane of the magnetic meridian, 76° 42'.45													
Oct. 17.	10h. 13m., A. M.	10° & 190°	2	S	76° 51'.40	76° 52'.91	76° 52'.14	-0'.77	76° 39'.97	32	47°	30.170	Clear; fresh S. W. wind on the 17th. Cloudy; strong south wind on the 18th. Do. Do. Do. Do. Do. Do. Do. Do. Do. Do.
" 18.	11 37 "	20° & 200°	2	N	76° 54'.43	77° 27'.18	77° 27'.07	-0'.11	76° 40'.54	32	52°.5	30.090	
" 17.	10h. 32m., A. M.	30° & 210°	2	S	77° 24'.37	78° 22'.90	78° 24'.23	+1'.33	76° 38'.18	32	47°.5	30.170	
" 18.	11 53 "	40° & 220°	2	N	77° 30'.00	79° 40'.63	79° 42'.91	+2'.28	76° 37'.51	32	53°.5	30.090	
" 17.	10h. 59m., A. M.	50° & 230°	2	S	78° 21'.22	81° 20'.53	81° 20'.55	+0'.02	76° 40'.48	32	49°	30.170	
" 18.	0 12 P. M.	60° & 240°	2	N	78° 24'.59	83° 14'.21	83° 14'.73	+0'.52	76° 39'.42	32	54°	30.084	
" 17.	11h. 40m., A. M.	70° & 250°	2	S	79° 38'.56	85° 23'.21	85° 22'.09	-1'.12	76° 43'.35	32	50°	30.172	
" 18.	0 31 P. M.	80° & 260°	2	N	79° 42'.70	87° 38'.01	87° 38'.67	+0'.66	76° 36'.74	32	54°.75	30.090	
" 17.	0h. 11m., P. M.	90° & 270°	2	S	81° 19'.59	90° 00'.59	90° 00'	-0'.59		32	50°	30.172	
" 18.	0 55 "		2	N	81° 21'.47						55°	30.084	
" 17.	0h. 35m., P. M.		2	S	83° 14'.63						50°	30.172	Do. Cloudy; strong south wind.
" 18.	1 14 "		2	N	83° 13'.81						54°.75	30.084	
" 17.	0h. 53m., P. M.		2	S	85° 23'.09						51°.5	30.172	
" 18.	1 30 "		2	N	85° 23'.34						55°.5	30.084	
" 17.	1h. 12m., P. M.		2	S	87° 37'.81						51°.5	30.172	Do.
" 18.	1 45 "		2	N	87° 38'.22						56°	30.078	
" 18.	2h. 12m., P. M.		2	N	90° 00'.22						56°.5	30.070	Do. Cloudy; strong south wind.
" 18.	2 57 "		2	S	90° 00'.96						56°	30.070	
Dip, by two hundred and fifty-six observations on needle No. 2, observed in the various azimuths stated in column three, and reduced, by computation to the plane of the magnetic meridian, 76° 39'.52													

From the foregoing table we have the following exhibit of the magnetic dip at Rouse's Point:

	Needle No. 1.	Needle No. 2.	Mean of both Needles.
By thirty-two observations made in the plane of the magnetic meridian,	76° 40'		} 76° 40'.42
By sixty-four observations made in the plane of the magnetic meridian,		76° 40'.84	
By two hundred and fifty-six observations made at every 10° of azimuth, from 0° to 80° inclusive, and reduced to the plane of the magnetic meridian,	76° 42'.45	76° 39'.52	76° 40'.98

Showing scarcely a sensible difference between the dip observed by both needles in the plane of the magnetic meridian and that deduced from the observations on both needles, in various azimuths, from 10° to 80°, inclusive.

The results shown in column ten of table A, seem exceedingly satisfactory for both needles, especially when it is considered that an error of 1', in reading the inclination at the azimuth of 70°, would cause an error in the computed dip of 2'.6, and a like error at the azimuth of 80° would cause an error in the computed dip of 5'.5.

A very slight defect in the instrument, indeed, either in the form of the axle of the needle observed on, or the want of perfect freedom from magnetism in the metal of which the dip-circle is composed, would operate as sufficient cause to produce a much greater error than 1' in the observed inclination at those high azimuths, even supposing no errors to be made in the actual reading of the needles.

But we consider the quantities in column nine as the more correct indices of the perfection of the form of the axles of the needles, and of the freedom of the dip-circle from magnetism and from ferruginous matter.

In regard to needle No. 1, the quantities in that column show that the greatest difference between the observed inclination in any azimuth, and the inclination computed from the data afforded by the observed azimuthal angle, and the observed dip in the plane of the magnetic meridian, is only 1'.73.

In regard to needle No. 2, the greatest difference is 2'.28, but the next greatest is only 1'.33.

The character of this instrument and the form of the axles of its needles have been still farther tested, and in a manner equally satisfactory, by the following highly interesting series of observations, made at the astronomical station on the east shore of Lake Memphremagog, in Stanstead, Canada East, by Lieutenant A. W. Whipple, between the 1st and 7th of November, 1845.

These observations and the several results are exhibited in the table marked B, as rendered by Lieutenant Whipple. The mode of observation adopted by him was, first, to ascertain the dip by both needles from careful observations made with the dip-circle, in the plane of the magnetic meridian; he then observed at every 15° of azimuth from 0° to 90°, turning the plane of the dip-circle round from north towards the west, and then in the several planes, at right angles to the former ones.

By combining the inclinations observed in pairs of planes at right angles to one another, the equivalent dip for the plane of the magnetic meridian was deduced by the formula

$$\text{Cotan.}^2 \delta = \text{Cotan.}^2 i + \text{Cotan.}^2 i'$$

In which i represents the inclination observed in any azimuthal plane, i' that observed in another azimuthal plane perpendicular to the former, and δ the equivalent dip reduced to the plane of the magnetic meridian.

Here, too, are shown, in column eight, the values of δ'' , deduced by the formula previously quoted, in order to compare them directly with δ' , here represented by i and i' in column seven, and the difference, $+$ or $-$, between δ' and δ'' are shown in column nine as the true indices of the perfection of the instrument in respect to the form of the axles of the needles and the freedom of the dip-circle from magnetism and matter having any attractive or repulsive effect upon the needles.

B

LIV. *Observations of the dip of the magnetic needle, made in the plane of the magnetic meridian, and also in various azimuths, at every 15° from 0° to 90°, and from 270° to 360°; with Major Graham's dip instrument, by Gambey of Paris.*

At the astronomical station on Lake Memphremagog, in Stanstead, Canada East. Latitude 45° 00' 29".2, N.; Longitude 4h. 48m. 50s. W.

OBSERVER.—Lieutenant A. W. Whipple, United States Corps of Topographical Engineers.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Date.	Approximate mean solar time of observation.	Magnetic azimuth of plane of dip-circle, reading of verniers.	No. of Needle.	Polarity of Marked end of Needle.	Dip observed in azimuth by each needle.	Dip in azimuth by observation.	Computed dip in azimuth.	Excess of computed over observed dip in various azimuths.	Dip reduced to plane of the magnetic meridian.	No. of obser- vations.	Thermo- meter. (Fah.)	Barom- eter.	Remarks.
1845.													
Nov. 1.	2h. 13m., P.M.	00° & 180°	1	N	76° 07'.41	76° 07'.83			76° 07'.83	32	63°	28.849	The whole day was cloudy and damp; there having been a violent storm of wind and rain the preceding night.
	3 00 "			S	76° 08'.25						59°	28.839	
Nov. 1.	3h. 23m., P.M.	0° & 180°	2	S	76° 05'.81	76° 08'.96			76° 08'.96	32	59°	28.840	
	4 04 "			N	76° 12'.12						57°.5	28.840	
Nov. 4.	11h. 00m., A.M.	0° & 180°	1	N	76° 10'.25	76° 09'.14			76° 09'.14	32	62°.5	28.884	Morning very foggy; the day cloudy; much rain last night; atmosphere moist; wind south-east.
	4 37 P.M.			N	76° 08'.03						63°.5	28.884	
Nov. 6.	11h. 20m., A.M.	0° & 180°	2	N	76° 11'.25	76° 08'.58			76° 08'.58	32	44°	28.866	Wind S.W. and a fresh breeze; cloudy in the morning; fair in the afternoon.
	5 00 P.M.			S	76° 05'.91						43°	28.873	
Nov. 7.	9h. 59m., A.M.	0° & 180°	2	S	76° 06'.19	76° 08'.89			76° 08'.89	32	43°	28.990	
	1 33 P.M.			N	76° 11'.59						46°.5	28.975	

Dip observed on the plane of the magnetic meridian, by a mean of one hundred and sixty observations on two needles, . . . 76° 08'.64

		θ			δ^o observed.	δ^o computed		δ					
Nov. 4.	11h. 25m., A. M.	195° & 15°	1	S	76° 37'.81	76° 36'.68 = i	76° 35'.84	-0'.84	76° 09'.72	32	65°	28.884	See above remark for the 4th Nov. On the 5th the weather was cloudy and rainy. A light south wind.
	5 00 P. M.			N	76° 35'.56						63°	28.889	
Nov. 4.	11h. 51m., A. M.	285° & 105°	1	S	86° 24'.22	86° 22'.30 = i	86° 20'.80	-1'.50	76° 09'.72	32	66°	28.884	
" 5,	10 35 "			N	86° 20'.38						54°	28.873	
Nov. 4.	0h. 16m., P. M.	210° & 30°	1	S	77° 58'.34	77° 57'.42 = i	77° 56'.44	-0'.98	76° 09'.97	32	67° 5	28.884	
" 5,	10 50 A. M.			N	77° 56'.50						54°	28.728	
Nov. 4.	0h. 38m., P. M.	300° & 120°	1	S	82° 58'.88	82° 59'.35 = i	82° 58'.10	-1'.25	76° 09'.97	32	70°	28.884	
" 5,	11 37 A. M.			N	82° 59'.81						54°	28.727	
Nov. 4.	0h. 56m., P. M.	225° & 45°	1	S	80° 07'.75	80° 05'.98 = i	80° 06'.18	+0'.20	76° 08'.77	32	70°	28.884	
" 5,	11 55 A. M.			N	80° 04'.22						54°	28.725	
Nov. 4.	1h. 17m., P. M.	315° & 135°	1	S	80° 07'.03	80° 06'.95 = i	80° 06'.18	-0'.77	76° 08'.77	32	68° 5	28.884	
" 5,	0 16 "			N	80° 06'.87						55° 5	28.719	
Nov. 4.	1h. 42m., P. M.	240° & 60°	1	S	82° 58'.56	82° 58'.42 = i	82° 58'.10	-0'.32	76° 08'.20	32	68° 2	28.884	
" 5,	0 34 "			N	82° 58'.28						56° 5	28.716	
Nov. 4.	2h. 01m., P. M.	330° & 150°	1	S	77° 57'.91	77° 55'.85 = i	77° 56'.44	+0'.59	76° 08'.20	32	68° 7	28.884	
" 5,	0 56 "			N	77° 53'.78						55° 2	28.712	
Nov. 4.	2h. 26m., P. M.	255° & 75°	1	S	86° 23'.91	86° 23'.89 = i	86° 20'.80	-3'.09	76° 10'.12	32	69°	28.884	
" 5,	1 18 "			N	86° 23'.88						53° 5	28.710	
Nov. 4.	2h. 45m., P. M.	345° & 165°	1	S	76° 37'.84	76° 36'.36 = i	76° 35'.84	-0'.52	76° 10'.12	32	70°	28.884	
" 5,	1 38 "			N	76° 34'.88						53° 2	28.705	
Nov. 4.	3h. 14m., P. M.	270° & 90°	1	S	89° 59'.09	90° 00'.17 = i	90° 00'.00	-0'.17	76° 10'.12	32	63° 5	28.884	
" 5,	1 56 "			N	90° 01'.25						53° 5	28.706	

Dip, by three hundred and twenty observations on needle No. 1, observed in the various azimuths stated in column three, and reduced by computation to the plane of the magnetic meridian, . . . 76° 09'.356

Nov. 7.	9h. 19m., A.M.	90° & 270°	2	S	89° 59'.25	89° 59'.41	90° 00'.00	+0'.59	76° 07'.51	32	40° 5	28.996	See above remark on the weather of the 7th.
	1 19 P.M.			N	89° 59'.56								
"	10h. 17m., A.M.	15° & 195°	2	S	76° 32'.88	76° 34'.92 = <i>i</i>	76° 35'.84	+0'.92	76° 07'.51	32	44°	28.990	
"	1 48 P.M.			N	76° 36'.97								
"	10h. 31m., A.M.	105° & 285°	2	S	86° 20'.53	86° 20'.20 = <i>i</i>	86° 20'.80	+0'.40	76° 07'.51	32	44° 2	28.989	
"	2 01 P.M.			N	86° 19'.88								
"	10h. 48m., A.M.	30° & 210°	2	S	77° 53'.44	77° 56'.00 = <i>i</i>	77° 56'.44	+0'.44	76° 08'.14	32	44° 2	28.988	
"	2 15 P.M.			N	77° 58'.56								
"	11h. 03m., A.M.	120° & 300°	2	S	82° 58'.44	82° 58'.18 = <i>i</i>	82° 58'.10	-0'.08	76° 08'.14	32	45° 2	28.986	
"	2 27 P.M.			N	82° 57'.91								
"	11h. 19m., A.M.	45° & 225°	2	S	80° 03'.25	80° 05'.04 = <i>i</i>	80° 06'.18	+1'.14	76° 06'.17	32	46° 8	28.986	
"	2 40 P.M.			N	80° 06'.84								
"	11h. 32m., A.M.	135° & 315°	2	S	80° 01'.81	80° 04'.11 = <i>i</i>	80° 06'.18	+2'.07	76° 06'.17	32	47° 2	28.985	
"	2 53 P.M.			N	80° 06'.41								
"	11h. 46m., A.M.	60° & 240°	2	S	83° 03'.72	82° 60'.26 = <i>i</i>	82° 58'.10	-2'.16	76° 07'.85	32	47° 7	28.984	
"	3 05 P.M.			N	82° 56'.81								
"	0h. 04m., P.M.	150° & 330°	2	S	77° 51'.72	77° 54'.50 = <i>i</i>	77° 56'.44	+1'.94	76° 07'.85	32	47° 7	28.982	
"	3 16 "			N	77° 57'.28								
"	0h. 19m., P.M.	75° & 225°	2	S	86° 22'.09	86° 21'.89 = <i>i</i>	86° 20'.80	-1'.09	76° 07'.93	32	46° 8	28.981	
"	3 32 "			N	86° 21'.59								
"	0h. 36m., P.M.	165° & 345°	2	S	76° 33'.28	76° 34'.97 = <i>i</i>	76° 35'.84	+0'.87	76° 07'.93	32	46°	28.980	
"	3 44 "			N	76° 36'.66								

Dip, by three hundred and twenty observations on needle No. 2, observed in the various azimuths stated in column three, and reduced by computation to the plane of the magnetic meridian, . . . 76° 07'.53

Table B affords the following exhibit of the dip by the observations made at the Stanstead station, in Canada East:

	Needle No. 1.	Needle No. 2.	Mean of both needles.
By sixty-four observations made in the plane of the magnetic meridian,	76° 08'.48		} 76° 08'.64
By ninety-six observations made in the plane of the magnetic meridian,		76° 08'.80	
By three hundred and twenty observations made at every 15° of azimuth, between 0° and 90°, and between 270° and 360° of the azimuth circle, and reduced to the plane of the magnetic meridian,	76° 09'.35	76° 07'.53	76° 08'.44

Here we have a closer coincidence even, than before, between the dip observed by the two needles in the plane of the magnetic meridian, and that deduced from the azimuthal observations.

What is also particularly satisfactory in this series is, that the greatest difference between any one of the reduced dips found in column ten and the dip derived from one hundred and sixty observations on the two needles, in the plane of the magnetic meridian, is, for needle No. 1, only 1'.48, and for needle No. 2, only 1'.47.

The greatest difference, in column nine, between the inclination observed in any azimuth at this station, and that computed for the same azimuth, is, for needle No. 1, only 3'.09, and this is for an azimuth so great as 75° from the magnetic meridian. The next greatest difference for this needle is only 1'.5.

The greatest difference, in that column, for needle No. 2, is only 2'.16, being for azimuth 60°, the next greatest is 2'.07, and the third in order is 1'.94.

The tests afforded by the two series of observations presented in tables A and B, of the qualities of the instruments, both as to the accuracy of form of the axles of the two needles, and the freedom of the metal of which the instrument is composed from magnetism and from all matter of a nature to attract or repel the needles from the true angles of inclination, seem exceedingly satisfactory, and must be considered as entitling the extensive series of observations that have been made with it to every confidence. It will be remembered, too, that these tests have been thus rigidly applied after the instrument has been in use nearly five years, and they show that it has not been deteriorated in its qualities by the many and very extensive journeys that have been performed with it amidst many very trying difficulties, resulting from the peculiarities of the country it has traversed.

We must not omit to acknowledge the credit due to that distinguished artist, Mr. Gambey of Paris, for the production of so perfect an instrument for measuring the magnetic dip.

LV. *Canaan Corner, Vermont and Canada Boundary.*

Latitude 45° 00' 49", N.; Longitude 4h. 46m. 04s., west. Observations for the dip made in the plane of the magnetic meridian, by Major Graham.

NOTE.—The point of observation is one hundred and thirty feet north-west from the iron monument on Hall's Stream, which marks the eastern extremity of the line of Valentine and Collins, running thence along the northern limit of the states of Vermont and New York, (under the provisions of the treaty of Washington, of 1842,) to the river St. Lawrence, at St. Regis.

December 19, 1845.

Mean time of observation.	Temperature (Fah.)	Polarity of marked end of needle.	Dip observed with poles direct and reversed.	No. of readings.	Dip by each needle.	Total No. of readings.
1h. 31m., P. M.	42°	N	NEEDLE No. 1. 76° 24'.31	24 }	76° 22'.95	48
2 03 P. M.	39°	S	76° 21'.6	24 }		
2h. 30m., P. M.	38°	N	NEEDLE No. 2. 76° 25'.12	24 }	76° 24'.01	48
3 00 P. M.	37°	S	76° 22'.91	24 }		

Dip, by a mean of ninety-six observations on the two needles, 76° 23'.48

The weather was cloudy, with an occasional slight fall of snow and a very gentle wind from the south-west during the observations. The snow two feet deep upon the ground. The observations were made under a tent free from iron fixtures.

These are the last observations made in the field during this season.

ERRATA IN THE PRECEDING PAPER.

Page 333, transpose the date, February 12th, to head the observations with marked end of needle A, north pole.

“ 334, and following pages, italicise the words, “First,” “Second,” &c.

“ 339, in tables two and three insert the initials *J. D. G.* in the last column, as observer.

“ 341, sixth line from top, for “The calculations were therefore received,” read *The calculations were therefore reviewed.*

“ 345, omit the words “AND DECLINATION,” in the running head, from this page to the end of the paper.

“ 351, place the remarks commencing, “Having applied the magnets,” in relation to reversing the poles of the needle, in a column on the right side of the table, opposite to the repetition of needle No. 1 with marked end north.

“ 354, last line, for “71° 55'.85,” read 71° 50'.7.

“ 363, first line, for “late the Widow Michean's,” read, *late the Widow Michean's.*

“ 371, thirteenth line from top, for “77°51'.07,” read, 76°51'.07.

“ 375, table A, fifth line from top, for “4h. 53m. 25s.,” read, 4h. 53m. 27s.

“ 378, third line from top, longitude of the astronomical station at Lake Memphremagog, for 4h. 48m. 50s., W. read, 4h. 48m. 52s., W.

“ 378, table B, end of first part of the table, for “Dip observed on,” read, *Dip observed in.*

☞ It must be remarked that the repetition of the name of the same station, which so often occurs, was intended to have been a running heading, at the top of the pages. See pages 333 and 346.

PART OF COL. SABINE'S NORTH POLAR CHART,

Exhibiting the Observations of Magnetic Intensity. Trans. Am. Phil. Soc. 2^d Series Vol. 9 N. 44.

